

LG31 Printer

Documentation Kit

EK-LG31C-DK-001

INTRODUCTION

This documentation kit provides user information to support the LG31 Printer. It contains the following manuals:

- EK-LG31C-IN-002 LG31 Printer
(V1.31.000-CSS and Later Variants)
Installation Manual
- EK-LG31C-UG-002 LG31 Printer
(V1.31.000-CSS and Later Variants)
User's Guide

LG31 Printer (V1.31.000—CSS and Later Variants)

Installation/Operator's Manual

Order Number: EK-LG31C-IN-002

**Prepared by
U.S. Area EIC Publication Services**

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Preface

Purpose

This manual provides information on the installation and operation of the LG31 300 LPM Line Matrix Printer. It contains instructions and procedures to help a user install, power-up, set/load, operate, and maintain the LG31 printer.

NOTE

The LG31 printer is installed, maintained, and supported by Digital Equipment Corporation.

Manual Organization

This manual is organized as follows:

- **Chapter 1 General Information**—Contains a product overview, operational/programming features, options, and printer specifications.
- **Chapter 2 Installation and Checkout** – Provides step-by-step instructions for proper unpacking/installation of the LG31 printer and ac power cord connection.
- **Chapter 3 Controls and Indicators** – Describes the LG31 printer controls and indicators.

- **Chapter 4 Setting Communications and Print Parameters** – Describes the parameters that may be set on the LG31 printer.
- **Chapter 5 Printer Diagnostics** – Describes the LG31 self-tests and alignments test.
- **Chapter 6 Printer Operation** – Describes user operation procedures.
- **Chapter 7 Operator Maintenance** – Describes operator troubleshooting tools and maintenance procedures.
- **Appendix A LED Display List** – Contains a complete list of LG31 printer readouts.
- **Appendix B Parameter Selection** – Contains the program mode parameters and the function mode options.
- **Appendix C LG31 Country Kits** – Contains the country kit information.

Related Documentation

The Customized LG31 Documentation Kit EK-LG31C-DK consists of the following:

LG31 Printer (V1.31.000-CSS and Later CSS Variants) User's Guide, EK-LG31C-UG

LG31 Printer (V1.31.000-CSS and Later CSS Variants) Installation and User's Guide, EK-LG31C-IN

LG31 Printer Pocket Service Guide, EK-LG31E-PS

LG31 Printer Technical Manual, EK-LG31E-TM

LG31 Printer Illustrated Parts Breakdown, EK-LG31A-IP

Conventions

In writing this manual, the following conventions have been adopted for the mechanical objects listed below

- Control Panel Keys = Capitalized key legend

Example: OFF LINE

- LED Three-Character Display = Bracketed three characters including flashing printer mode dots

Example: [.8.8.8]

- Number Designated Keys = Parenthesis enclosed number designation

Example: (4)

Notes, Cautions, and Warnings

Throughout this manual Notes, Cautions, and Warnings have the following meanings:

NOTE: The information is important to the understanding of the process being described.

CAUTION: The information describes a process that can damage the equipment or software.

WARNING: The information describes a process that can harm the user.

Assistance

If you have a problem with the LG31 printer, carry out the following steps:

1. Confirm that the problem can be repeated by recreating the identical conditions leading up to the problem. A vital step may have been overlooked which is causing the problem.
2. Identify the problem using the "Troubleshooting" section in Chapter 7 and the list of LED display messages in Appendix A to determine if the problem can be resolved in-house. If not, the local Digital Equipment Corporation Customer Service organization should be contacted.

3. If required, report the problem to Digital Equipment Corporation Customer Service. Consult your service contract for the information required to process your call.

WARNING

Dangerous voltages exist in the LG31 printer. There are no internal user serviceable parts. Refer servicing to qualified service personnel.

FCC Statement (A)

Notice

This equipment generates, uses, and may emit radio frequency energy. The equipment has been type tested and found to comply with the limits for a Class A computing device pursuant to Subpart J of Part 15 of FCC rules, which are designed to provide reasonable protection against such radio frequency interference. Operation of this equipment in a residential area may cause interference in which case the user at his own expense will be required to take whatever measures may be required to correct the interference.

Chapter 1

GENERAL INFORMATION

1.1 Overview

This chapter contains an overview of the LG31 300 LPM Line Matrix Printer (hereafter referred to as the LG31 printer). It includes a brief description of the printer and listings of the electrical, mechanical, and operational specifications.

1.2 General Description

The LG31 printer is a line matrix printer incorporating a serial I/O (see Figure 1-1). The LG31 printer uses fan-folded, tractor-fed paper stock, and operates at 100-240 volts, 50-60 Hertz (Hz). The printer is primarily used in data processing and office environments, and can be operated by non-technical users. The LG31 must be installed by a trained Field Service engineer. It is maintained and supported by Digital Equipment Corporation.

The hardware environment for the printer consists of all the electrical and mechanical interfaces. The electrical interfaces are the host communication port, and the ac power inlet. The mechanical interfaces are the platen gap, paper thickness adjuster, the paper path/tractors, ribbon cartridge, and the outer/inner control panels. The printer is compatible with low to mid-range PDP and VAX systems.

No specialized software is required. For data exchange with the host computer, the LG31 has an RS-232-C port.

The firmware resident in the printer interprets and executes commands (control sequences) sent from the host computer or entered by an operator at the printer's outer or inner control panels. There are self-test diagnostics integrated in the printer firmware to verify operational integrity and identify hardware faults.

The printer is capable of printing at a speed of 300 Lines Per Minute (LPM) in upper case characters, in a data processing font, at 10 Characters Per Inch (CPI), and at 6 Lines Per Inch (LPI). At this speed, a projected workload of 15-20K pages per month at 50 percent duty cycle (assuming an eight-hour day) is attainable.

1.3 Major Components

The major components of the LG31 printer are as follows:

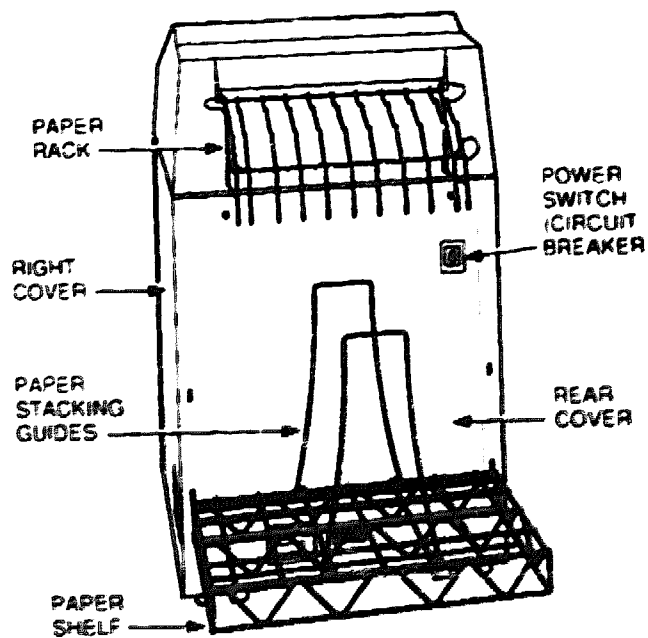
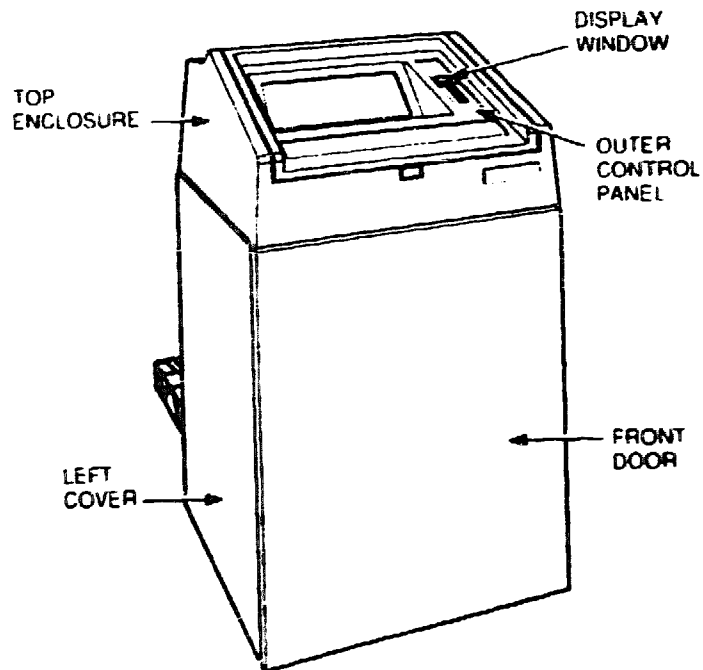
- Control panels
- Printer mechanism
- Control electronics
- Serial interface
- Power supply

1.3.1 Control Panels

There are two control panels on the LG31 printer: an Outer Control Panel keypad for common operations, and an Inner Control Panel keypad for more complex printing operations. The inner control panel has a three-character LED display, which indicates printer status and operator-correctable faults. The display panel is visible above the outer control panel through a window in the top cover. An operator can key in commands (see Chapter 5) on the inner control panel to invoke diagnostic self-tests, modify printer parameters, or initiate specified printer functions.

Also included is an audio operator-alerting alarm for power-up/fault detection, and an initialization switch, which erases current configuration settings and restores the printer to factory settings. Refer to Chapter 3 for configuration menu selection/modification, Chapter 4 for programming printer functions, and Chapter 5 for operator-selected keypad functions. Appendix A lists all the display codes.

Figure 1-1: LG31 Printer



RE LG3175A B

Configuration of the printer is accomplished with the use of the control panel and printed menus. The printer is capable of operating in either 7 or 8 bit modes and with the Digital serial I/O protocol.

1.3.2 Printer Mechanism

The LG31 printer mechanism consists of mechanical and electromechanical hardware. The printer mechanism performs ribbon/paper motion and translates the binary print data to printed characters on paper by means of the print shuttle.

1.3.3 Control Electronics

The control electronics of the LG31 printer coordinates the functions and operations of the serial interface, control panel, and printer mechanism.

1.3.4 Serial Interface

The EIA RS-232-C serial interface provides the bidirectional communications link between the host and the printer. Bidirectional communications allow print data to be sent to the printer and various types of data (XON/XOFF protocol, status reports, printer identification, and so on) to be sent to the host from the printer. The ASCII/ISO 7-bit code and alphanumeric characters are used for information interchange between the printer and the host (data source).

1.3.5 Power Supply

The LG31 printer's power supply provides regulated dc power to the control electronics and printer mechanisms. The ac power is rectified and regulated to assure reliable printer operation. The power supply automatically adjusts to ac input voltages in the range of 100 to 240V ac at 50 to 60 Hz and constantly monitors the dc output voltages.

1.4 Printed Circuit Boards

The LG31 printer printed circuit boards are listed in Table 1-1.

Table 1-1: LG31 Printed Circuit Boards

Board	Description	Part No.	Location
SCPI	Shuttle Control Panel Interface	29-26721-00	On access door between outer and inner control panels.
SHAD	Shuttle Head Actuator Driver	29-26729-00	Vertically mounted in top rear of printer.
SMDP	Shuttle Matrix Display Panel	29-26720-00	On inner control panel.
SMMB	Shuttle Matrix Mother Board	29-27261-01	Inside rear access door (left side).
SMIH	Shuttle Matrix Image Hardware	29-26731-00	In logic card cage (right side).
SMIM	Shuttle Matrix Imaging Microprocessor	29-28651-01	In logic card cage(right- side).
SMMC	Shuttle Matrix Motor Control	29-26735-00	In logic card cage (right side).
SMSI	Shuttle Matrix Serial Interface	29-26723-00	Piggyback on SMSM.
SMSM	Shuttle Matrix System Microprocessor	29-28650-01	In logic card cage (right side).
SPSD	Shuttle Power Supply Discharge	29-26724-00	Inside rear access door below the capacitor.
SPSM	Shuttle Power Supply Master	29-26734-00	In power supply card cage (left side).
SPSR	Shuttle Power Supply Regulator	29-26732-00	In power supply card cage (left side).
SPSX	Shuttle Power Supply Filter	29-26722-00	In ac switch box, rear of printer, near power ON/OFF switch.

1.5 Printer Feature Summary

The LG31 printer provides the following features:

- **Bolding**
- **Underlining text**
- **Single, double-width characters**

- Single, double, or triple-height characters
- Autowrap
- Line feed/new line mode
- Hex dumping
- Digital multinational 8-bit character set (U.S. ASCII)
- National Replacement Character (NRC) sets (see Section 1.6.5).

1.6 Specifications

1.6.1 LG31 Printer Specifications

Table 1-2: LG31 Printer Specifications

Printer Dimensions

Unpacked

Width	737.5 cm (29.0 in)
Depth	63.5 cm (25.0 in)
(with Paper Tray)	104.1 cm (41.0 in)
Height	123 cm (48.4 in)
Net Weight	131 kg (287 lbs)

Packaged

Width	77.5 cm (30.5 in)
Depth	88.9 cm (35 in)
Height	156.2 cm (61.5 in)
Weight	171 kg (376 lbs) (includes 16 kg (35.2 lbs) of accessories consisting of paper shelf, upper paper rack, and ribbon cartridge)

Installation Area Requirements

Width	137 cm (54 in) (To allow air flow clearance for printer side vents)
Depth	206.5 cm (104 in) (To allow free access to front and rear paper handling areas, the ON/OFF switch, and the power cables)

Electrical

Voltage Range	100 to 240 V ac
---------------	-----------------

Table 1-2 (Cont.): LG31 Printer Specifications

NOTE	
The printer's universal power supply automatically accepts international voltage and frequency variations.	
Input Frequency Range	50 Hz to 60 Hz
Harmonic Distortion	5% maximum allowable
Power Rating	
Standby	50 W
Printing	400 W
Shuttle Frequency	20 Hz
Dissipated Power	
Standby	171 BTU/hr
Printing	1368 BTU/hr
Radio Frequency Interference	Tested/certified to RFI standards FCC 15, Subpart J, Class A; VDE 0871 Class B
Acoustic Noise	LNPA 6.7 bels LPA 55 dBA
Operating	
Altitude	2.4 km (0 to 8,000 ft)
Temperature	10°C to 40°C (50°F to 104°F) Maximum allowable reduced by factor 1.8°C/1000 m (1°F/1000 ft)
Relative humidity	10% to 90% non-condensing with a maximum wet bulb temperature of 28°C (82.4°F) a minimum dew point 2°C (35.6°F)
Non-operating	
Altitude	4.9 km (0 to 17,700 ft)
Temperature	-40°C to 66°C (-40°F to 150.8°F) Maximum allowable reduced by factor 1.8°C/1000 m (1°F/1000 ft)
Relative Humidity	5% to 95% non-condensing
Printing	
Line Length	33.5 cm (13.2 in)
Lines Per Inch (LPI) Spacing	2, 3, 4, 6, 8, 10, 12 (plus double and triple vertical expansions)
Characters Per Inch (CPI)	5, 6.67, 8.35, 10, 12, 13.3, 15, 16.7 (plus double horizontal expansion of each)
Paper Slew	50.0 cm/sec (20 in/sec)
Line Feed	12.5 msec at 6 lines/inch
Horizontal Tabs	198 positions
Vertical Tabs	66 positions

Table 1-2 (Cont.): LG31 Printer Specifications

Paper/Forms	
Paper Width	76.2 mm (3 in) to 420.1 mm (16.54 in)
Form Length	8.4 mm (0.33 in) to 559 mm (22 in)
Fan Folds	152 mm (6 in) to 305 mm (12 in)
Paper Weight	90 g/m ² (24 lbs) for single ply paper
Form Thickness	Less than 0.63 mm (0.025 in)
Card Stock	Up to 163 g/m ² (100 lbs) can be used

1.6.2 Resident Fonts

Table 1-3: Resident Fonts

Font	Horizontal Pitch (CPI)		
	5,6,67,8,35	10	12,13,3,15,16,7
Data processing	Yes	Yes	Yes
NLQ	Yes	Yes	Yes
OCR-A	NLQ	Yes	NLQ
OCR-B	NLQ	Yes	NLQ

"Yes" indicates that the horizontal pitch is available in the current font.

"NLQ" indicates that when either OCR-A or OCR-B font is selected, and a horizontal pitch other than 10 CPI is selected, the NLQ font is substituted automatically. If the horizontal pitch is subsequently changed to 10 CPI, the printer will return to the selected OCR font.

1.6.3 Recommended Paper Weights

Table 1-4: Recommended Paper Weights

Number of Parts	Recommended Paper Weight	Carbon Insert Sheet Weight
1	56 g/m ² (15 lbs)	—
2, 3 or 4	50 g/m ² (13.5 lbs)	19 g/m ² (8 lbs)
5 or 6	45 g/m ² (12 lbs)	19 g/m ² (8 lbs)

1.6.4 Print Speeds

Print speeds are quoted in lines per minute (LPM) with the printer set at 6 LPI, for each available combination of font and horizontal pitch in characters per inch.

Table 1-5: Print Speeds

Font	Horizontal Pitch (CPI)			
	5,6.67,8.35	10	12,13.3,15	16.7
DP Upper-case Only	See Note	300	300	147
DP Upper- and Lower-case	See Note	240	240	105
NLQ Upper-case Only	See Note	82	82	147
NLQ Upper- and Lower-case	See Note	65	65	105
OCR-A Upper-case Only†	—	65	—	—
OCR-B Upper-case Only†	—	65	—	—

†The OCR-A and -B fonts are available in upper-case only.

Note

The print speeds for the 5, 6.67, and 8.35 CPIs are at least 50 per cent of the print speeds of the CPIs from which they are created, that is 10, 13.3, and 16.7 CPIs.

1.6.5 Resident Character Sets

The resident character sets are:

- Digital Supplemental
- U.S. ASCII
- ISO Great Britain
- Digital Holland
- Digital Finland
- ISO France
- Digital Technical
- VT100 Special Graphics
- Digital French Canada
- ISO Germany
- ISO Italy
- JIS Roman (Japan)
- Digital Norway/Denmark
- ISO Spain
- Digital Sweden
- Digital Switzerland
- ISO Norway/Denmark
- Digital Portugal

The complete character sets are given in Appendix A of the User's Guide.

Chapter 2

INSTALLATION AND CHECKOUT

2.1 Overview

This chapter contains the unpacking, checkout and installation procedures for the LG31 printer. This printer must be installed by trained personell only. Installation time is approximately one hour. The following tasks must be performed before the LG31 printer is operational.

- Remove all packaging
- Position the printer
- Remove all transit items
- Install the ribbon, paper, and paper rack/tray/guides
- Install electrical connections (ac power, host interface)
- Set the host interface parameters (for example, baud rate)
- Set the printer parameters (for example, autowrap mode)

2.2 Unpacking

2.2.1 Inspection

There are two cartons for each printer:

1. Country Kit carton (OPEN FIRST label) containing:
 - AC power cord (see Appendix D)
 - User information (EK-LG31C-DK) which contains:
 - *LG31 Printer User's Guide*, EK-LG31C-UG
 - *LG31 Printer Installation/Operator's Manual*, EK-LG31C-IN
2. Strapped skid-crate containing:
 - LG31 printer
 - Paper rack
 - Paper shelf
 - Paper stacking guides (2)
 - Ribbon cartridge

WARNING

Do not attempt to move the 174 kg (374 lbs) skid-crated printer alone. Two people are required for unpacking and installation after the printer has been site-positioned.

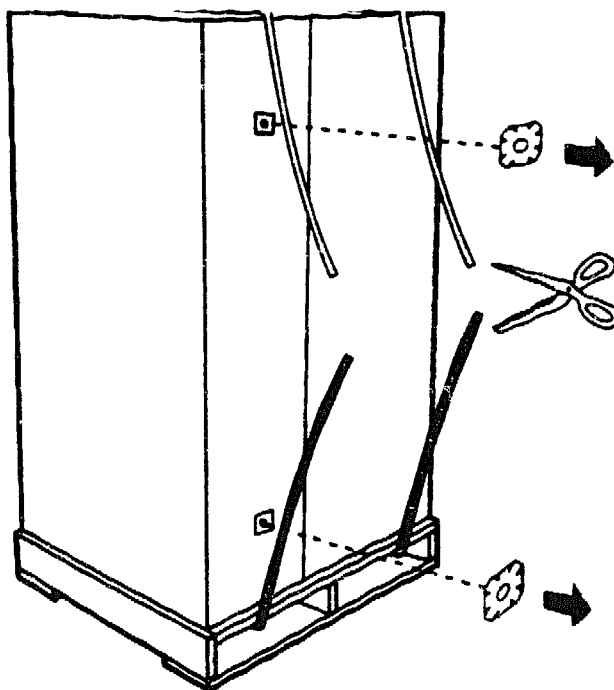
Inspect the exterior shipping container for punctures, crushed corners or sides. If any shipping or handling damage is found, notify the carrier immediately requesting the proper claim forms and procedures. In the event any equipment is missing or in error, notify the distributor from whom it was purchased.

2.2.2 Unpacking Procedure

Use the following procedure and illustrations when unpacking the LG31 printer. Save the red shipping screws, blocks, and brackets for reshipment.

1. Cut and remove the four shipping straps from shipping pack (see Figure 2-1).
2. Remove the country kit from the top of the printer carton.
3. Remove the screws holding the two tabs from the side of the carton using a 7/16" AF Wrench (see Figure 2-1).

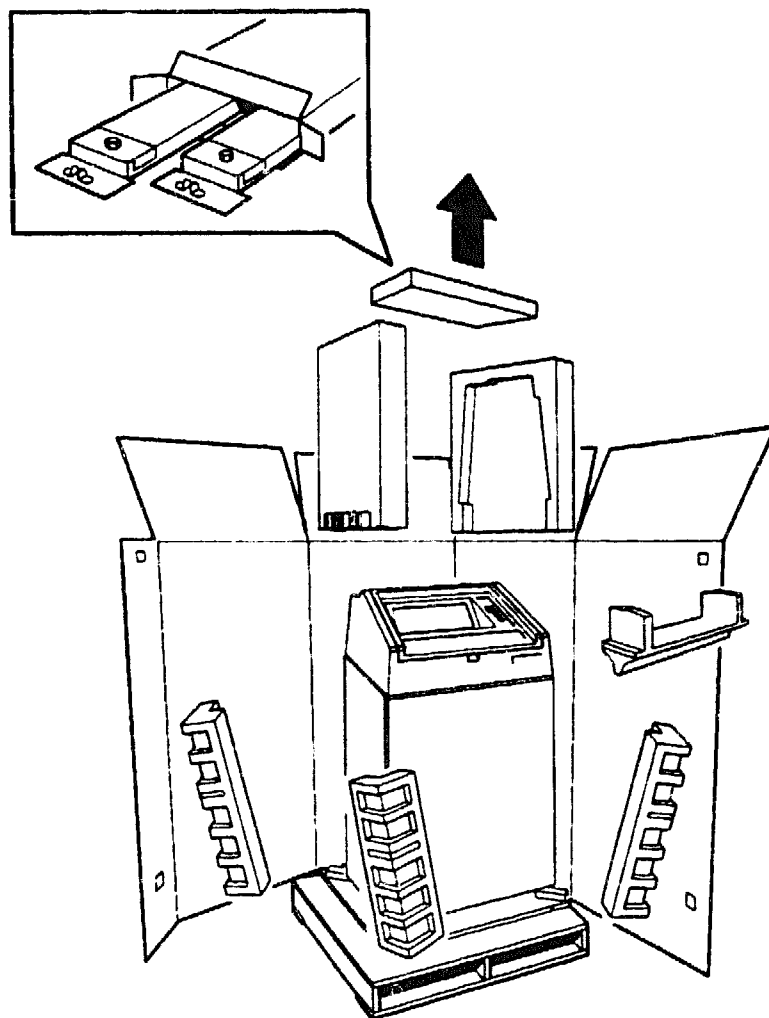
Figure 2-1: Cut Straps and Remove



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4. Open the carton and lift out the package containing the ramps from the top of the packing material (see Figure 2-2).

Figure 2-2: Opening Carton

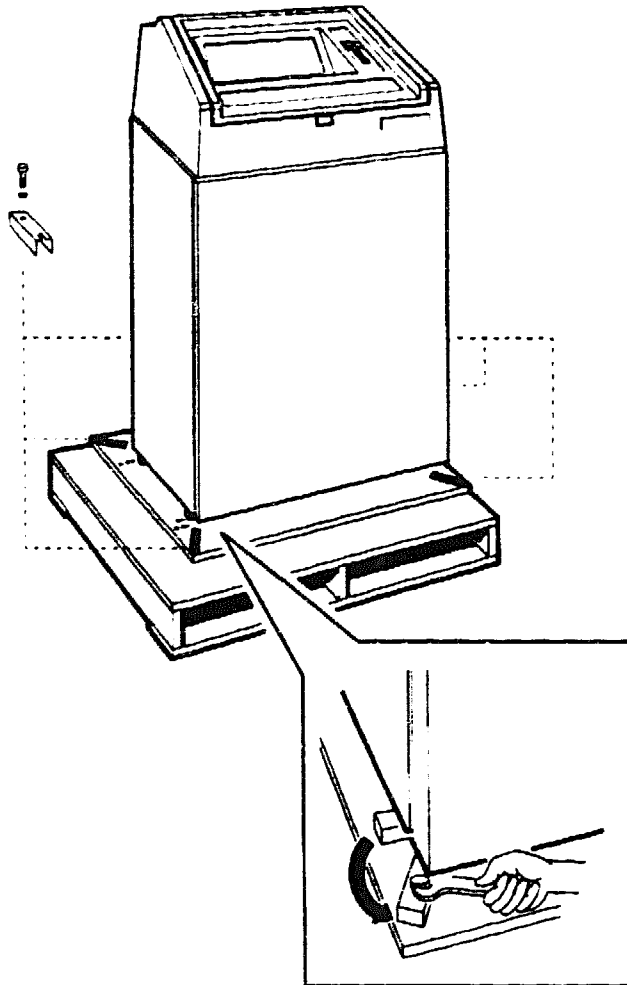


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5. Remove the packing material around the printer.

6. Remove the four metal brackets holding the printer to the wooden skid using a 9/16" AF Wrench (see Figure 2-3).

Figure 2-3: Removing Metal Brackets

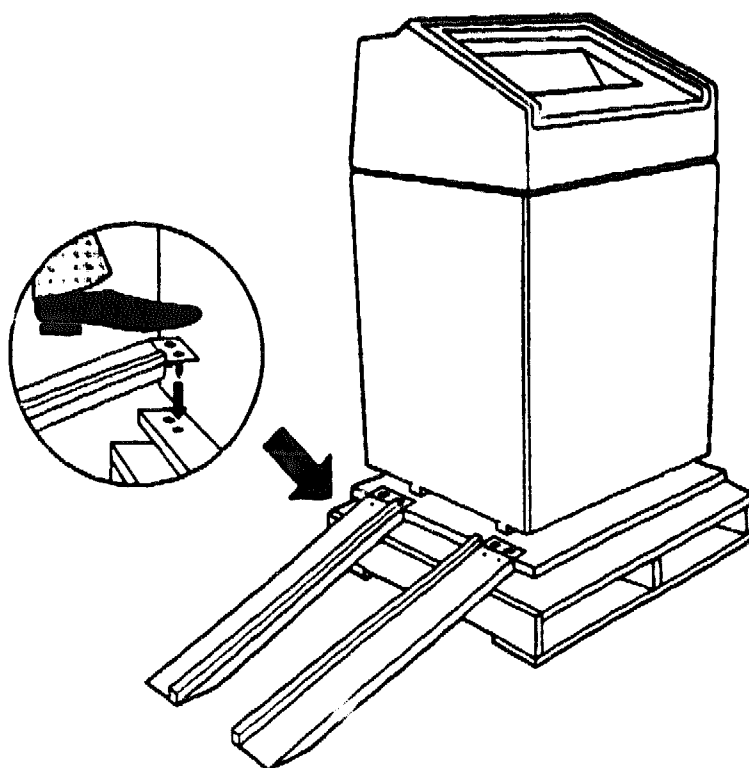


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7. Open the carton containing the ramps and remove them.

8. Position the ramps as shown in Figure 2-4 and force the teeth into the top level of the skid.

Figure 2-4: Positioning Ramps

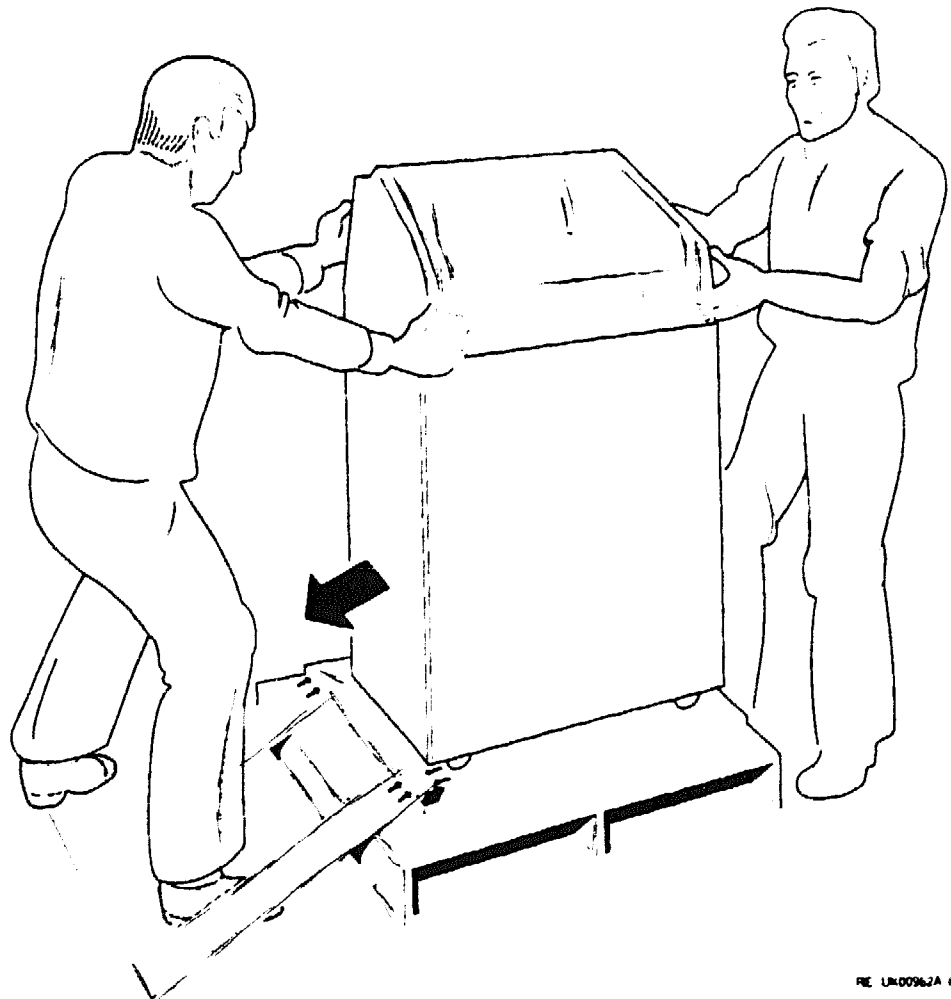


Note

Align ramp with one arrow to single arrow on skid and ramp with two arrows to two arrows on skid.

9. Carefully roll the printer down the ramp (see Figure 2-5).

Figure 2-5: Removing Printer from Pallet

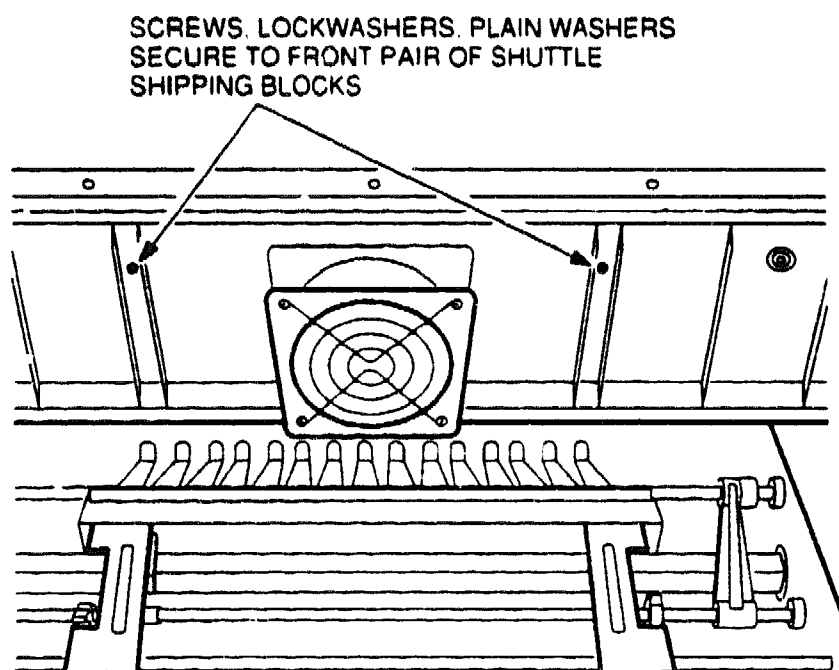


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10. Pull open printer front door (hinged at left side). Remove printer accessories paper rack, paper tray, paper guides, and ribbon cartridge (3 boxes).

11. Using an 8 mm socket wrench, remove four M5 x 30 red hex-head cap screws, M5 lock washers, and M5 plain washers securing the shuttle shipping blocks in place. These screws are accessible by the front door, which allows access to the bottom of the paper handling assembly (see Figure 2-6). The rear screws are behind the paper handling assembly, but easily removable by socket wrench.

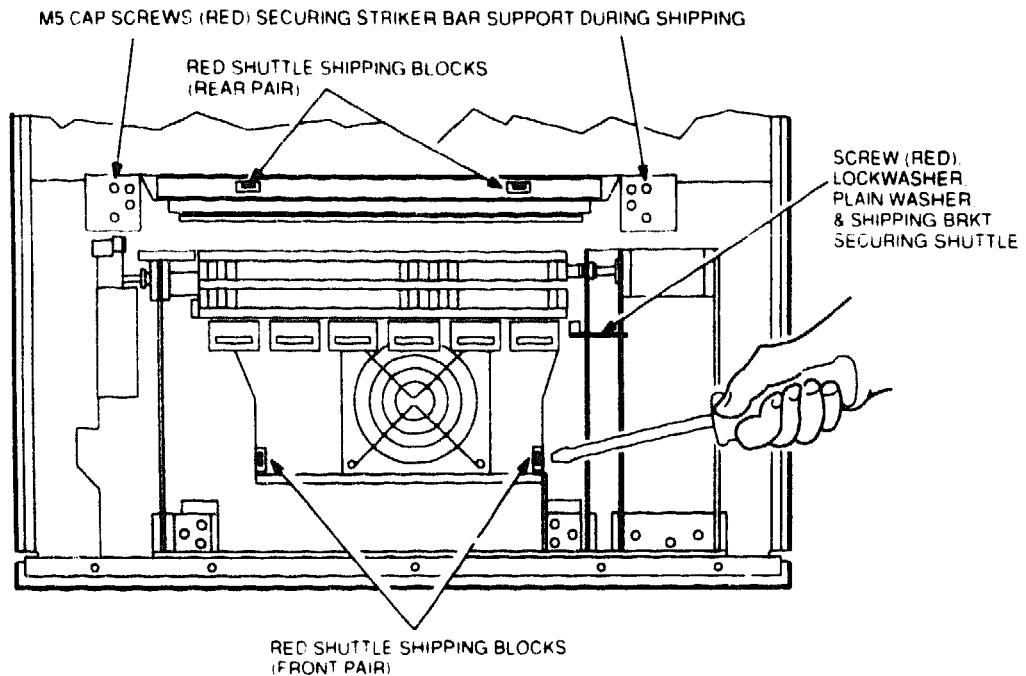
Figure 2-6: Top of Lower Front Interior



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12. Remove the two red rear shipping blocks by reaching up behind the paper handling assembly and removing the blocks through the front door.
13. Open printer top cover and shuttle access door (not shown) which is below the location where the ribbon cartridge will be installed (see Figure 2-7).

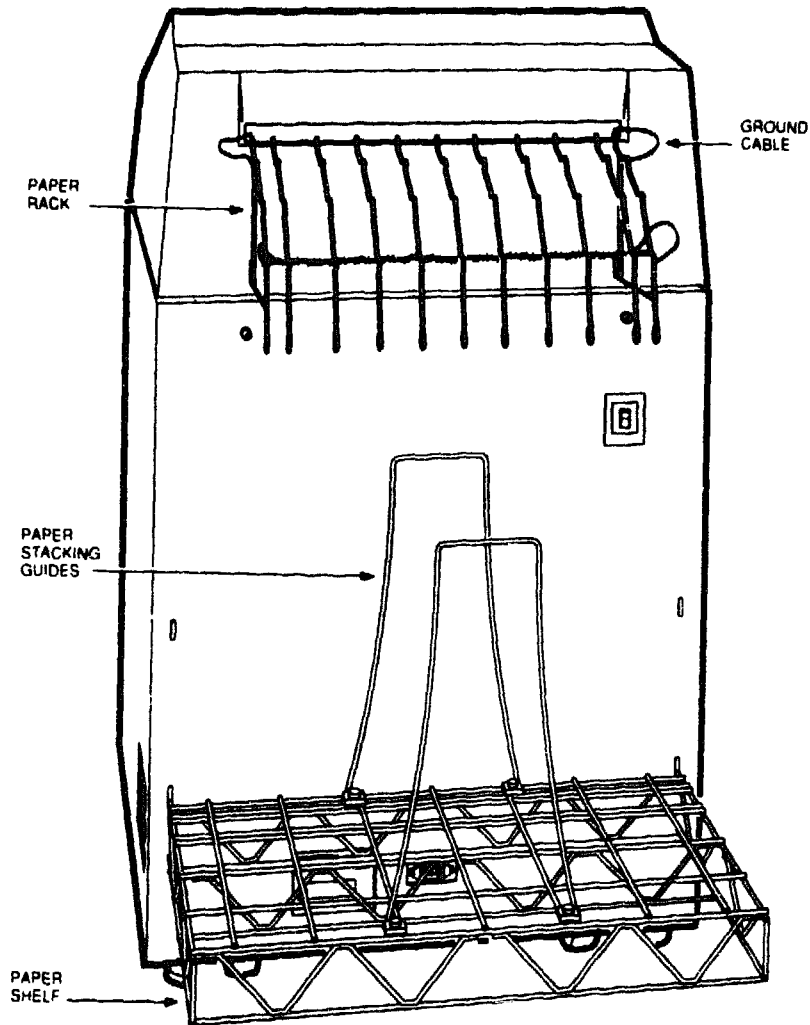
Figure 2-7: Top View - Shuttle Area



14. Remove the two red front shipping blocks through the shuttle access door. Use a screwdriver to pry the front shipping blocks from under the shuttle.
15. Remove the sample print out sheet. Retain for future test comparison (see Section 2.5). It is useful to move tractors to give more room for instruction 16. Care must be taken to avoid injury.
16. Remove two M5 x 28 red hex-head cap screws and plain washers securing the striker bar support blocks during shipping by using an 8 mm socket wrench (see Figure 2-7).
17. Remove the M5 x 16 red hex-head cap screw, M5 plain washer, turn shipping bracket used as shuttle horizontal constraint during shipping through 90° and slide out (see Figure 2-7).
18. Adjust printer leveling feet, if the printer is not level.
19. Install paper rack on back of printer as shown in Figure 2-8. Secure four grounding cables to stubs on paper rack. The other end of each grounding cable is secured inside the printer at the corners of the paper chute.

20. Secure clip end of static strap to paper tray. The stub end at the interface connector plate will be connected as shown in Figure 2-8.
21. Install paper stacking guides on paper shelf using thin screw attachments (see Figure 2-8).

Figure 2-8: Paper Handling Hardware



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2.3 Installation

An installation area of 137 cm wide by 107 cm deep (54 inches wide x 42 inches deep) is required. This provides free access and clearance to the printer's rear mounted paper rack, ON/OFF switch, paper tray, ac power cord, and serial interface cable for operating and maintenance purposes.

A power source of 100 to 240 volts, single phase, 50-60 Hertz (Hz) must be within 10 feet for connecting the ac power cord. Before inserting the plug into an ac wall outlet, be certain the ON/OFF power switch located at rear of the printer is set to OFF (0). The printer power supply is self-adjusting. There is no need to adjust the printer power supply to suit the mains source when this source is within the specifications.

The proper site environment requirements for LG31 printer installation are under "Specifications" in Chapter 1. Environmental conditions such as excessive humidity can cause paper sticking, while low humidity can cause static build-up.

It is recommended that the leveling feet be adjusted to make the printer level, if this has not already been done.

The procedure for setting/modifying printer parameters (speed (baud rate), autowrap, and so on) are described in Chapter 4. Chapter 4 contains initialization, and Chapter 5 contains power-up, and other operator-implemented procedures. Procedures for loading the paper and installing the ribbon cartridge are in Chapter 6.

2.3.1 Print Ribbon Cartridge

Refer to Section 6.3 on installing/replacing the print ribbon cartridge.

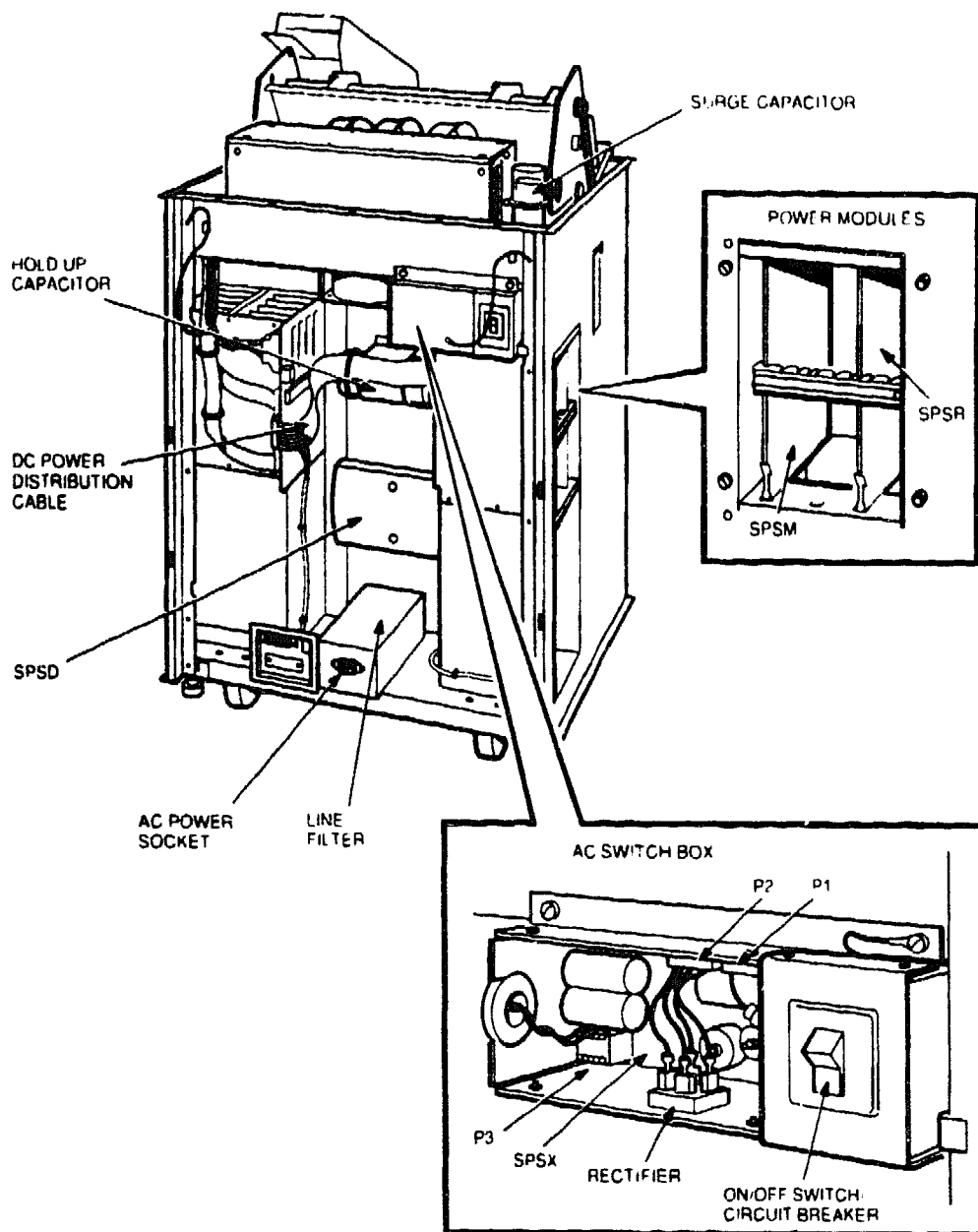
2.4 Apply Power to the LG31

The LG31 printer contains a universal power supply that works, without modification or adjustment, with any input in the specified range of voltage and frequency. To power up the LG31 printer, carry out the following:

1. Make sure the power switch (see Figure 2-9) is in the OFF position.
2. Take the power cord supplied in the country kit, and plug the female connector into the back of the LG31 printer (see Figure 2-9).
3. Plug the power cord male connector into the source power outlet.

The LG31 printer is now ready to be switched on.

Figure 2-9: Power Connection



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2.5 Powering and Testing the LG31 Printer

LG31 printer testing includes a self-test and a print test. The self-test is performed:

- Every time the printer power is switched on.
- After each print test.
- During normal operation.

Before turning the power on, load the printer with paper (see Chapter 6, Section 6.2). To turn the power on and run the print test, perform the following steps.

1. Turn the LG31 printer on by pressing the top section of the power switch (see Figure 2-9). The printer performs a series of self-tests (see Chapter 5, Section 5.2) and when completed, displays [O F L].
2. Press the (3) ON LINE key if [O n L] is displayed.
3. Press the (0) TEST CLR key until the LG31 begins to print. The LG31 will print the test pattern until you press the (0) TEST CLR key again.
4. Compare the printout from this test with the sample printout supplied with the printer.
5. If the printout is comparable, continue by running a configuration printout (see Section 4.3.1).
6. If the quality of the printout is unsatisfactory, perform the printer adjustments in chapter 5 of the Technical Manual.

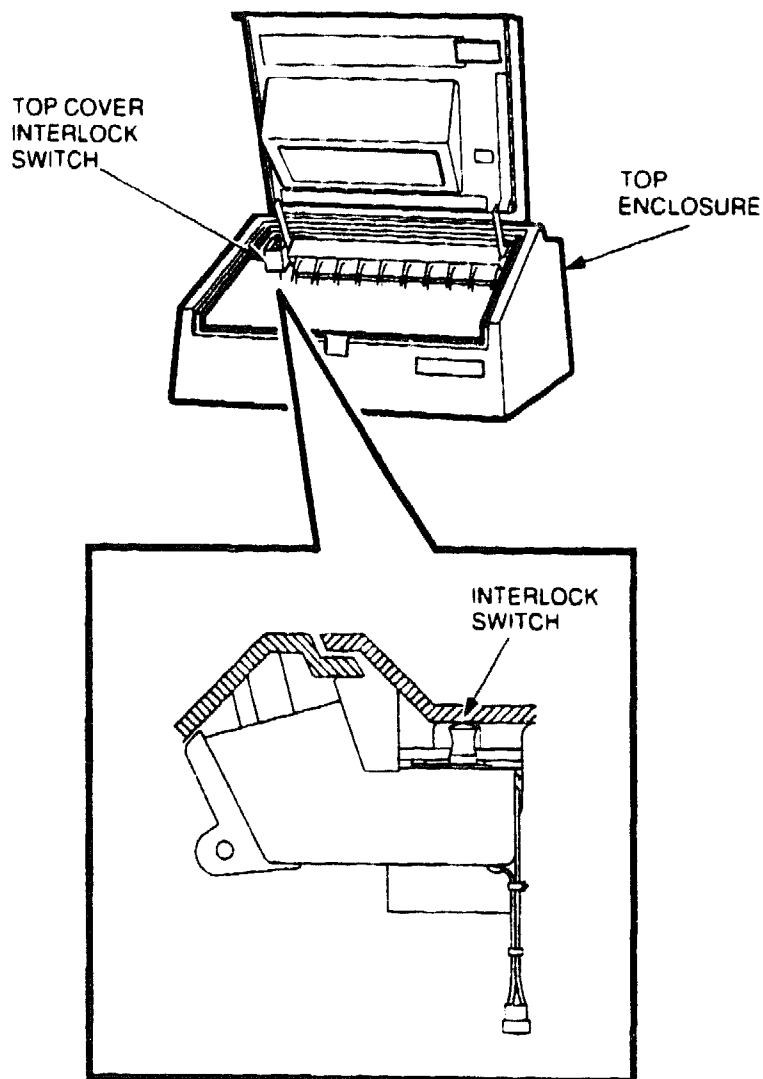
The configuration menu contains the state of the printer as shipped. You should print a copy of this menu and retain it for future reference. To print a copy of the configuration menu, perform the following steps.

NOTE

The factory settings for the printer parameters are contained in Chapter 7, Section 7.3 (Table 7-3). The setting of parameters at power-up and at reset are also listed in Chapter 7 (Table 7-4).

1. Make sure the LG31 is in the off-line mode ([O F L] is displayed). Press the (3) ON LINE key if [O n L] is displayed.

Figure 2-10: Cover Interlock Switch



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2. Open the top cover and pull the interlock switch (see Figure 2-10) out until it clicks. Do this within two seconds of opening the top cover.
3. Press the (1) PRG key to enter the initialization mode [P r o] is displayed. The LG31 will print the configuration menu.

4. Press the (0) TEST CLR key to return to the off-line mode ([O F L] is displayed).

When you reach this point, you have verified that the print quality is acceptable, and have a copy of the configuration of the LG31 as shipped. The printer is now ready for use.

2.6 Host To LG31 Printer Set-up Procedure

2.6.1 Interface Control Strap Settings

Figure 3-14 of the *LG31 PRINTER User's Guide* states that parity is disabled at interface strap B2. This is the factory setting and the recommended setting. This means that the serial interface must be set-up with no parity.

2.6.2 Serial Interface Settings for VAX/VMS

Before using the printer, the serial interface must be set-up correctly. The system manager must issue the following commands for the VAX/VMS operating system.

1. If the terminal line that will support the LG31 has not been set-up to support a spooled device then, go to instruction 3, otherwise, issue a DCL command such as the following:

```
$ stop/que que_name
```

where que_name is the name of the queue.

2. Stop the spooling on the terminal by issuing the DCL command:

```
$ set dev/nospool txal:
```

where txal is the name of the terminal in this case.

3. Set up the terminal line to have the following characteristics as shown below:

Terminal:	_TXA1:
Device_Type:	Unknown
Owner:	SYMBIONT_0001
Username:	SYSTEM

Input: 9600
Output: 9600

LFfill: 0
CRfill: 0

Width: 300
Page: 66

Parity: None

Terminal Characteristics

Interactive	Echo	Type_ahead	No Escape
No Hostsync	TTsync	Lowercase	Tab
Wrap	Scope	No Remote	Eightbit
No Broadcast	No Readsyc	Form	Fulldup
No Modem	No Local_echo	No Autobaud	No Hangup
No Brdcstmbx	No DMA	No Altypeahd	Set_speed
Line Editing	Overstrike editing	No Fallback	No Dialup
No Secure server	No Disconnect	Pasthru	No Syspassword
No SIXEL	No Soft	No Printer Port	Numeric
Graphics	Characters		Keypad
No ANSI_CRT	No Regis	No Block_mode	No Advanced_ video
No Edit_mode	No DEC_CRT	No DEC_CRT2	No DEC_CRT3

This can be accomplished by the DCL command:

```
$ set term txal: /pasthru/speed=9600/etc
```

Note

PASTHRU SHOULD ALWAYS BE SET.

4. Set the terminal line to support a spooled device by issuing the DCL command:

```
$ set dev/spool=(queue_name) txal:
```

where queue_name is the name of the queue.

5. Start the queue by issuing the DCL command:

```
$ ini/que/start/terminal queue_name/on=txal:
```

The LG31 can now be used.

2.6.3 RSX Settings

The terminal characteristic PASTHRU should be set.

2.6.4 RT-11 Settings

A command of the form ASSIGN TT1: LP: should be issued. This assumes a multi-terminal system. Refer to the RT-11 System User's Guide.

2.6.5 RSTS/E Settings

Refer to the RSTS/E System Manuals.

Note

* Indicates that the current setting is not affected by the terminal type.

Table 2-1: Default Characteristics

Name	Set	Name	Set
ADVANCED_VIDEO	no	INSERT/ OVERSTRIKE	*
ALTYPEAHD	no	INTERACTIVE/ PASSALL	*
ANSI_CRT	no	LFFILL	0
APPLICATION_KEYPAD/ NUMERIC_KEYPAD	*	LINE EDITING	*
AUTOBAUD	no	LOCAL_ECHO	*
BLOCK_MODE	no	LOWERCASE/ UPPERCASE	low
BRDCSTMBX	no	MODEM	no
BROADCAST	no	PAGE	66
CRFILL	0	PARITY	no
DEC_CRT	no	PASTHRU	yes
DEC_CRT2	no	PRINTER_PORT	no
DIALUP	no	READSYNC	*
DISCONNECT	*	REGIS	no
DMA	*	REMOTE	*
ECHO	*	SECURE_SERVER	*
EDIT_MODE	no	SET_SPEED	no
EIGHT_BIT	yes	SIXEL_GRAPHICS	no
ESCAPE	*	SOFT_CHARACTERS	no
FALLBACK	*	SPEED	9600
FRAME	*	SYSPASSWORD	no
FORM	yes	TAB	yes
FULLDUP/ HALFDUP	*	TTSYNC	*
HANGUP	no	TYPE_AHEAD	*
HARDCOPY/ SCOPE	scope	WIDTH	220
HOSTSYNC	*	WRAP	*

2.7 Connecting the Host to the LG31 Printer

The LG31 printer contains an EIA RS-232-C serial 25-pin interface connector. The 70-27717-01 cable is supplied with the host system. Connect the cable from the host to the LG31 printer.

Chapter 3

CONTROLS AND INDICATORS

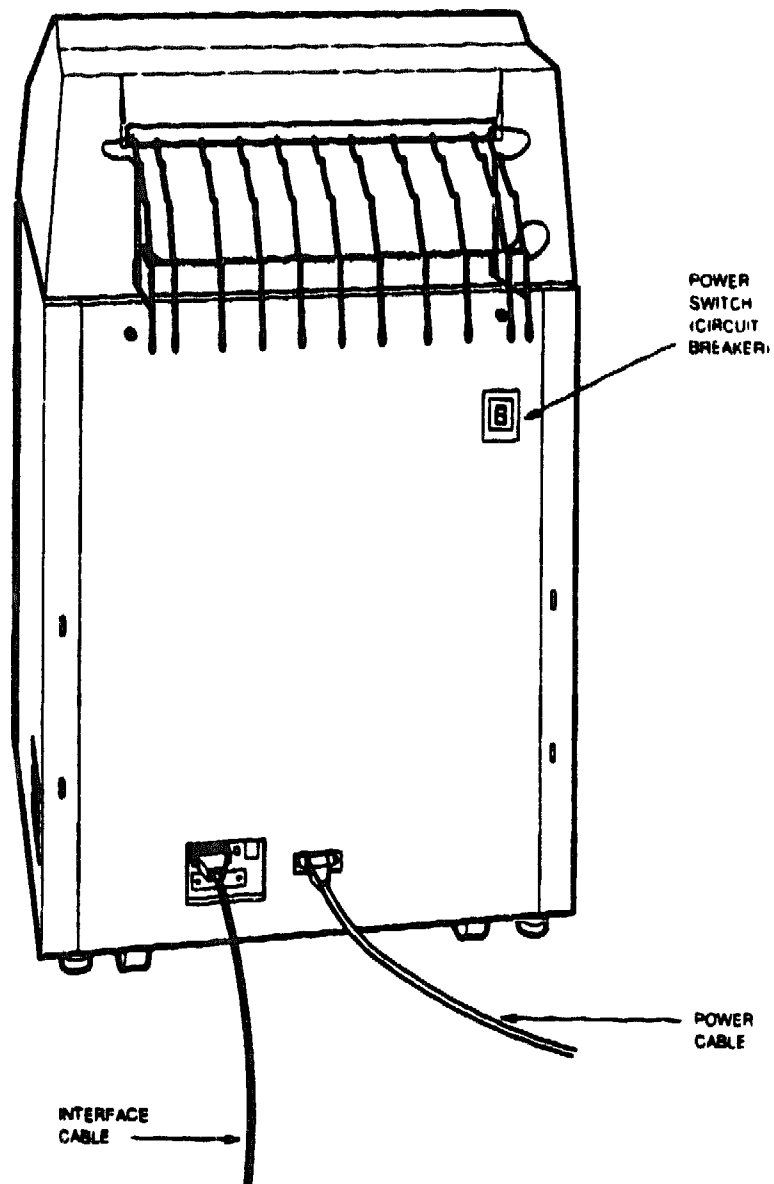
3.1 Introduction

This chapter describes all the operating controls and indicators available on the LG31 printer.

3.2 Power Switch ON/OFF

The power switch is located on the rear of the LG31 printer (see Figure 3-1). This is a two-position rocker switch/circuit breaker. In the ON position, top half pressed in, power is applied to the printer.

Figure 3-1: Power Switch

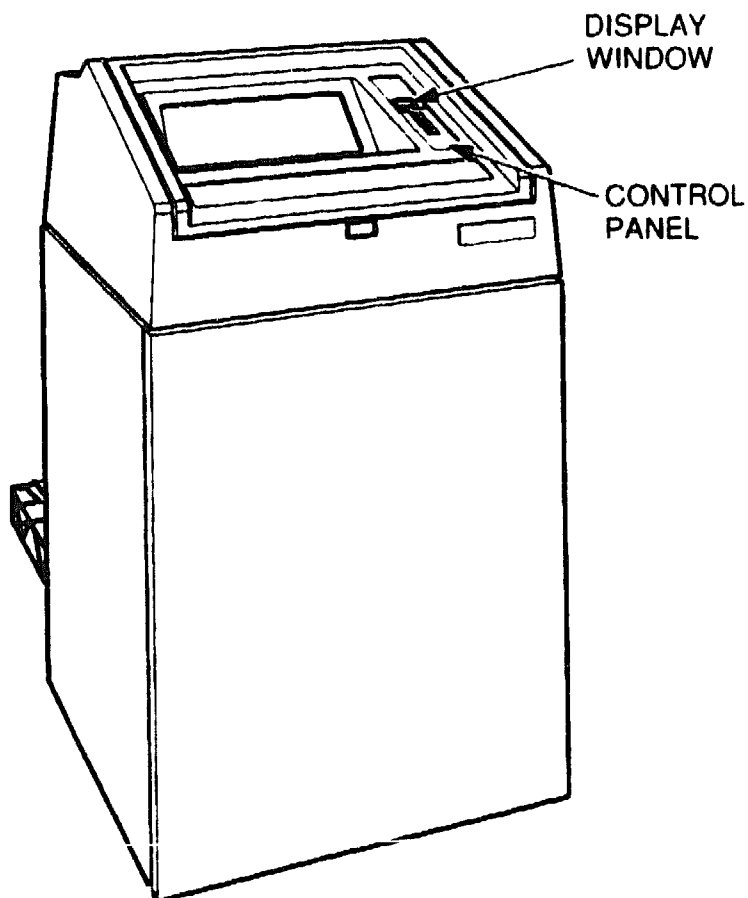


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3-2 CONTROLS AND INDICATORS

3.3 Outer Control Panel

Figure 3-2: Location of the Outer Control Panel



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The outer control panel, which is located on top of the LG31 (see Figure 3-2), contains the keys that let the operator perform routine functions:

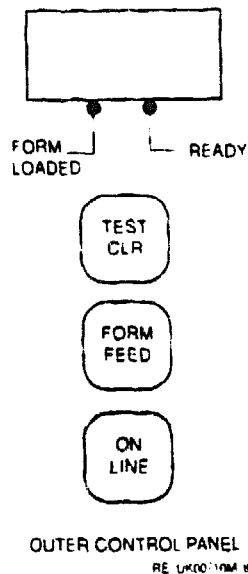
- Run the print test and the self-test.
- Switch the printer between the on-line and off-line modes of operation.
- Perform form feed operations.

3.3.1 Outer Control Panel Components

The outer control panel (see Figure 3-3) includes:

- A view window through which you can observe the three-digit display on the inner control panel.
- A three-key keypad. The key markings are:
 - TEST/CLR
 - FORM FEED
 - ON LINE

Figure 3-3: Outer Control Panel



NOTE

There is an audio alarm mounted on the inner control panel, which sounds when you power up the printer, and each time you press one of the control panel keys.

3.3.2 Outer Control Panel Keys

The function of the keys on the outer control panel (see Figure 3-3) are:

TEST CLR

When this key is pressed for more than 0.5 seconds in off-line mode, the LG31 starts the print test (a rolling pattern of all ASCII characters). The next time you press the TEST CLR key, the LG31 stops the print test and performs the self-test.

When this key is pressed for less than 0.5 seconds after clearing a fault or error condition, the LG31 resumes normal operation.

FORM FEED

When this key is pressed the LG31 advances the paper to top of the next form.

When the LG31 is on-line, the form feed operation is dependent upon the setting of printer control strap 26.

When the LG31 is off-line, the form feed operation is not dependent upon the setting of printer control strap 26.

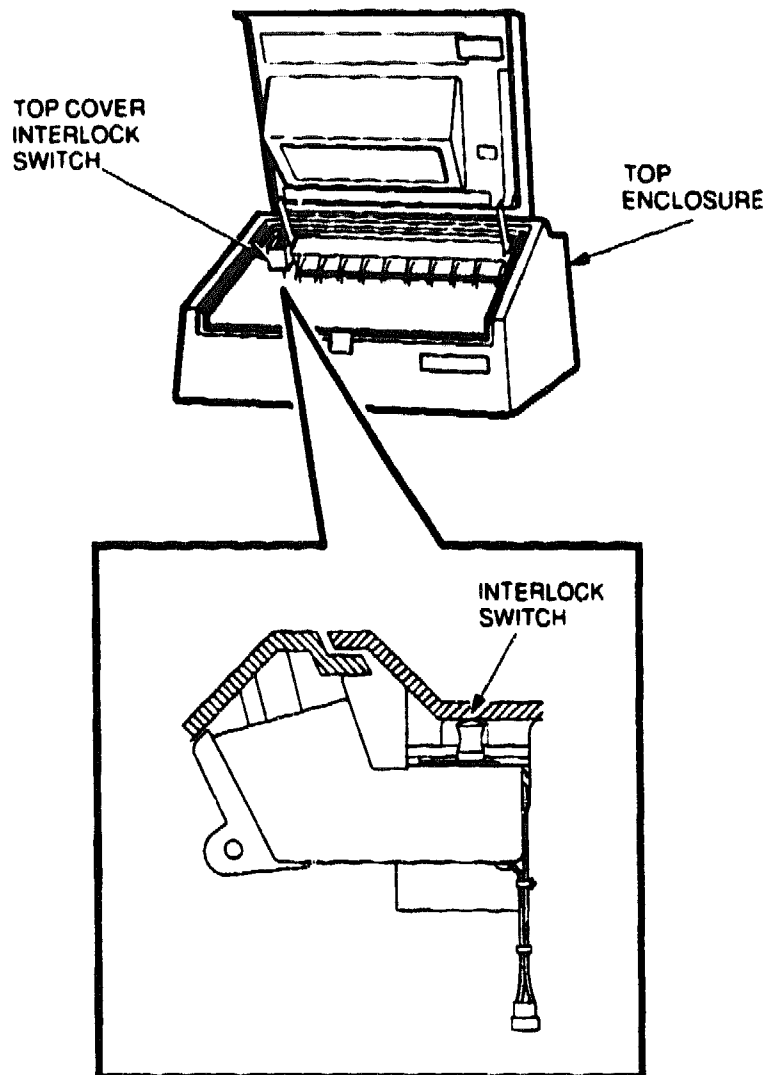
ON LINE

When this key is pressed, the printer toggles from off-line to on-line, the display changes from [O F L] to [O n L].

3.4 Top Cover Interlock Switch

The interlock (see Figure 3-4) is set to on when the top cover is opened, and in the on position, places the LG31 in standby mode. To override the interlock, turn the switch off, and pull the switch plunger up to its highest position.

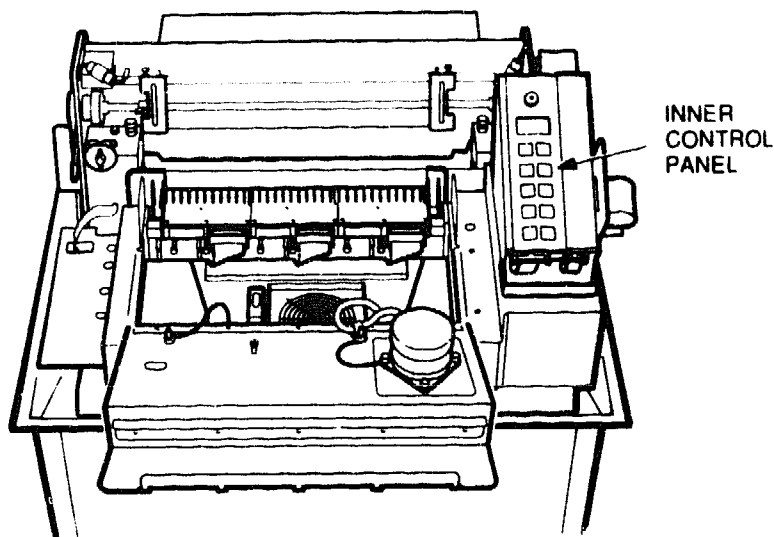
Figure 3-4: Cover Interlock Switch



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3.5 Inner Control Panel

Figure 3-5: Location of the Inner Control Panel



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The inner control panel, which is located inside the top cover (see Figure 3-5), contains the keys that let you control all operational functions of the LG31. These include:

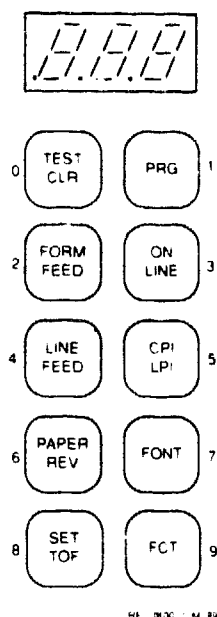
- Performing the same functions as the outer control panel.
- Modifying print parameters.
- Modifying serial interface parameters.
- Performing diagnostics.

The inner control panel (see Figure 3-6) includes:

- A three-digit (seven segments each) three-dot display.
- An audio alarm.
- An initialization switch.
- A ten-key keypad; the keypad markings are:
 - (0) TEST CLR
 - (1) PRG

- (2) FORM FEED
- (3) ON LINE
- (4) LINE FEED
- (5) CPI LPI
- (6) PAPER REV
- (7) FONT
- (8) SET TOF
- (9) FCT

Figure 3-6: The Inner Control Panel



In off-line mode, the keys may be regarded as soft pushbuttons and perform the functions indicated by their respective legends. However, once Program (PRG) mode is entered, the 10 keys are assigned new functions, which are automatically printed to guide the operator (see Appendix C for a complete listing). The pushbuttons may also be regarded as soft pushbuttons in Function (FCT) Select mode (see Appendix C for a complete listing).

All the available selections of print parameters and serial interface parameters are shown in Figure 3-7.

Figure 3-7: Configuration Menu

THE PRESENT CONFIGURATION IS: (44A513016 SY - 44A513017 IM)
FIRMWARE REVISION LEVEL V1.31.000-CSS

1. Font:
Style - 44A513017 Dataprocessing
CPI - 10 CPI
Country - US ASCII
Mode - Normal
Horizontal Expansion - X1
Vertical Expansion - X1
2. LPI - 6 lpi
3. Forms Control (lines):
Form Length - 66
Top Margin - 01
Bottom Margin - 66
4. Interface Control:
Interface Type - Serial
Input buffer length 3840
Interface Straps A:
0 1 2 3
12345678901234567890123456789012
00001000000001000000001010000001000
Interface Straps B:
0 1 2 3
12345678901234567890123456789012
01000100000000000000000000000000
Speed - 9600
Parity - Even
5. Margin Settings (columns):
Left Margin - None
Right Margin - 132
6. Horizontal Tabs (columns):
009 017 025 033 041 049 057 065 073 081
089 097 105 113 121 129 137 145 153 161
169 177 185 193 201 209 217
7. Vertical Tab stops:
8. Printer Control Straps:
Printer Straps A:
0 1 2 3
12345678901234567890123456789012
000000000000000000000000100001110010
Printer Straps B:
0 1 2 3
12345678901234567890123456789012
0000000000000000000000000000000000
Press the number '0' to return to normal operation.
To continue modification select (1-8).

3.5.1 Three-Character LED Display

The three-character/three-dot LED display (see Figure 3-8) is multifunctional and indicates the following.

- Printer modes, for example:
 - [O n L] ON LINE
 - [O F L] OFF LINE
 - [F c t] FUNCTION
- Configuration Menu settings, such as top/bottom margins, right/left margins, Characters Per Inch (CPI), Lines Per Inch (LPI) print spacing, that are used when changing the printer configuration.
- Fault codes (see Table 5-2 for a listing of the diagnostic codes) that are used with the printer self-test at power-up, after printing the test pattern, and during printer operation.

The three-dot indicators in the three-character LED display are display illuminated during self-tests. When illuminated, the dots indicate:

- Left dot FCT MODE—Printer is in Function Selection state. Press (9) FCT key to enter. Display reads [.F n c].
- Middle dot FORM LOADED - Electronic Vertical Format Unit (EVFU) form table has been downline loaded. See the *LG31 Printer User's Guide*.
- Right dot READY—Illuminated by the signal CTS received from the host computer (see Chapter 4, Section 4.2).

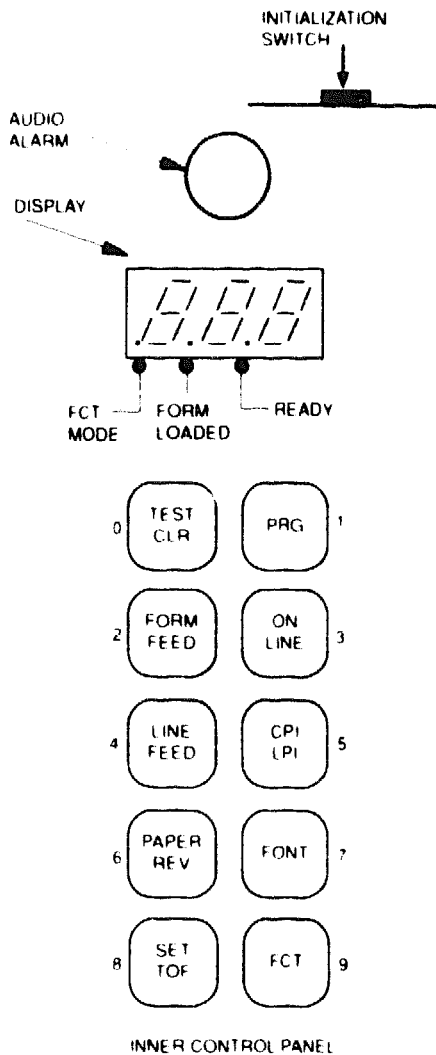
Refer to Appendix A for a complete listing of display readouts.

3.5.2 Audio Alarm

The audio alarm (see Figure 3-8) located at the top of the Inner Control Panel momentarily emits a sound at power-up, when a key is pressed, when a <BEL> code is received in on-line mode, and under any alarm condition, as follows:

- When a fault is detected (includes EVFU loading fault).
- When Paper Low condition is detected.

Figure 3-8: The Inner Control Panel Showing Display, Audio Alarm, Initialization Switch



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3.5.3 Initialization Switch

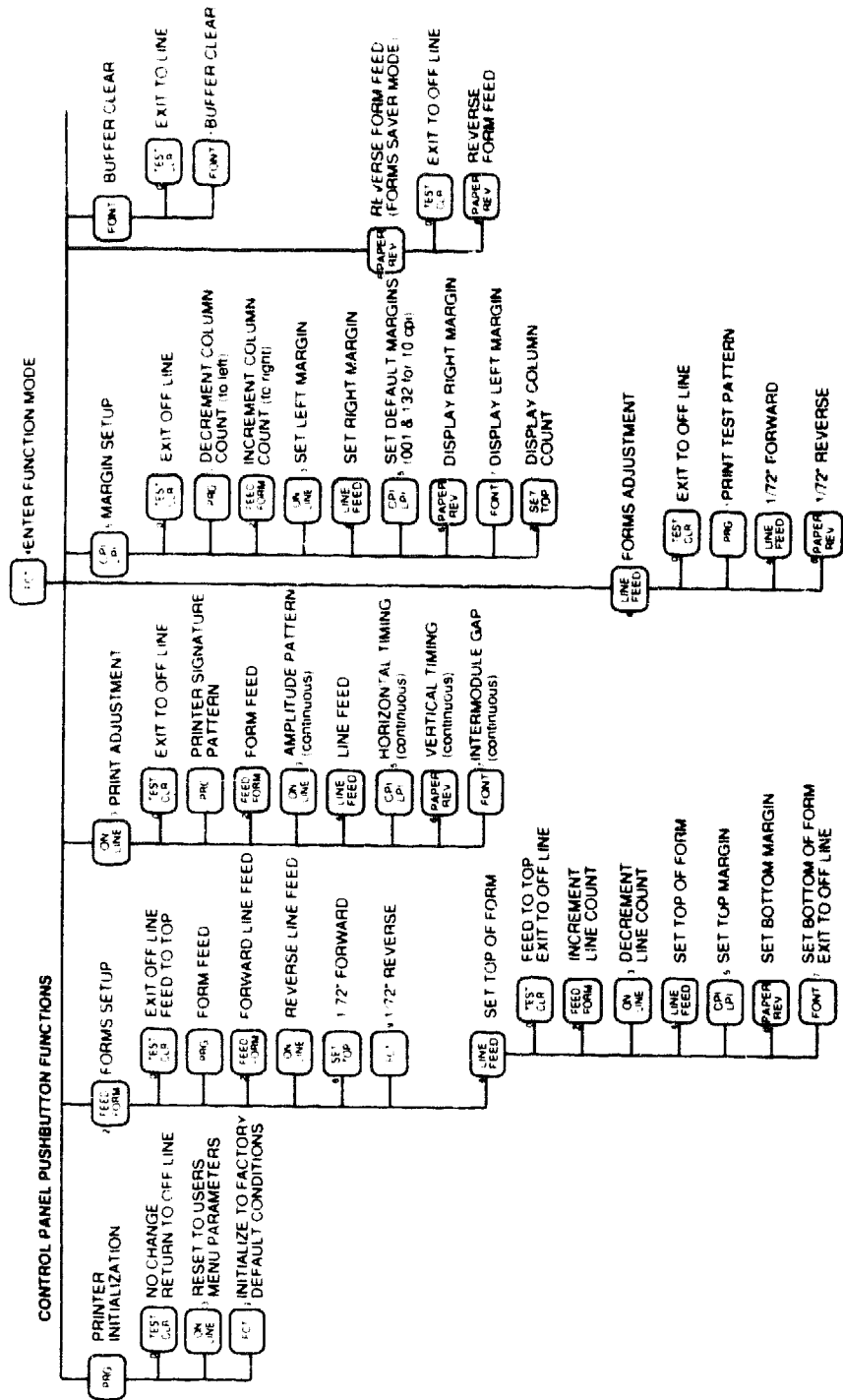
The initialization switch (see Figure 3-8) is a slide switch located at the top of the inner control panel that lets you initialize the printer after it is locked up. You can initialize it using the procedure detailed in Chapter 4, Section 4.5.1. In normal operation, the switch is in the leftmost position.

3.5.4 Key Functions

The three types of key functions are:

1. Initial key function (ON LINE, TEST CLR, PAPER REV). Refer to Table 3-1 for list.
2. Function select — Enter by pressing (9) FCT key. In this state, the left dot on the three-character LED display is illuminated. This state includes the printer initialization to default configuration, alignment patterns, top of form adjust, reverse form feed, buffer clear, forms setup, and margin setup. Return to off-line printer operation from any of these operations by pressing (0) TEST CLR key. See Figure 3-9 for a map of the function select combinations.
3. Program — Pressing the (1) PRG key causes the current configuration to be printed and places the printer in the programming state. In the programming state, the keys assume functions represented by adjacent numbers. See Chapter 4 for additional information.

Figure 3-9: Function Mode Key Operations



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Table 3-1: Initial Key Functions

Key	Key Function in OFF LINE Mode	Key Function in ON LINE Mode
(3) ON LINE	U = ON LINE selected. Toggles state to on-line mode.	Toggles state to off-line mode.
(0) TEST CLR	When pressed for more than 0.5 of a second, a rolling test pattern is printed in the DP font at 10 CPI. Pressing (0) TEST CLR again stops the test pattern.	No operation.
(1) PRG	Prints any data in the buffer, then prints current configuration and enters Programming state. See Chapter 4.	No operation.
(2) FORM FEED	Advances paper to the next top of form setting, once for each time key is pressed.	If printer strap 16 is set, functions the same as off- line. Otherwise, no operation.
(4) LINE FEED	Advances paper one line based on current LPI setting. When pressed and held down for one second, consecutive line feeds are performed at the rate of approximately three steps per second.	If printer strap 16 is set, functions the same as off- line. Otherwise, no operation.
(5) CPI LPI	Alternately displays CPI and LPI each time key is pressed. Holding key down causes settings available for the active font to be displayed on a rotating basis. The setting displayed when the key is released becomes the active selection. The CPI/LPI key displays the current submenu - that is, only the CPI values for the current font are displayed.	No operation. Displays are:

Key	Key Function in OFF LINE Mode	Key Function in ON LINE Mode
	CPI (DP)	LPI
	[10]	[06L]
	[12]	[08L]
	[13]	[10L]
	[15]	[12L]
	[16E]	[02L]
	[05]	[03L]
	[06]	[04L]
	[66]	
	[83]	
(6) PAPER REV	Moves paper in reverse direction 0.06 mm (1/72 in) each time the key is pressed. When pressed and held down for one second, consecutive 1/72 inch paper reverse feed steps occur at the rate of approximately three steps per second. Inoperative during Low Paper Print mode.	If printer strap A26 is set, functions same as off-line. Otherwise, no operation.
(7) FONT	Displays current font style when pressed. Holding key down causes available font styles CPI to be displayed on a rotating basis. The setting displayed when the key is released becomes the active selection. When a new font is selected, the horizontal spacing is initially set to the default spacing for the particular font. Displays for standard draft and Near Letter Quality (NLQ) are displayed only once:	No operation.

Key	Key Function in OFF LINE Mode				Key Function in ON LINE Mode
	CPI (DP)	CPI (& NLQ)	CPI (& OCR-A)	CPI (& OCR-B)	
	[10]	[10]	[OcA]	[Ocb]	
	[12]	[12]	[n12]	[n12]	
	[13]	[13]	[n13]	[n13]	
	[15]	[15]	[n15]	[n15]	
	[16E]	[16E]	[16E]	[16E]	
	[05]	[n05]	[n05]	[n05]	
	[06]	[06]	[06]	[06]	
	[66]	[66]	[66]	[66]	
	[83]	[83]	[83]	[83]	
(8) SET TOF	Set Top of Form to current position of paper. TOF is calculated upon form length in effect. It is assumed that the top printable dot row (±3 rows) of the form is aligned with notches in upper tractors before key is pressed. The form is then moved forward automatically to place the first line at the point on the following form.				No operation.

Key	Key Function in OFF LINE Mode	Key Function in ON LINE Mode
(9) FCT	Enters Function Selection state (refer to function procedures: Printer Initialization, Forms Setup, and Margin Setup). This key is also used to achieve Reverse Form Feed as follows: Press key (9) to enter Function Mode, then press key (6) for Reverse Form Feed (paper moves back one form length). Also used by service personnel in aligning printer.	No operation.
Function Mode Summary		
	State	Key
	INITIALIZATION	Press (1)
	FORM SETUP	Press (2)
	PRINT REVIEW	Press (3)
	FORMS ADJUST	Press (4)
	MARGIN SETUP	Press (5)
	REVERSE FORM FEED	Press (6)
	BUFFER CLEAR	Press (7)
	Refer to Chapter 4 for the above function mode procedures.	

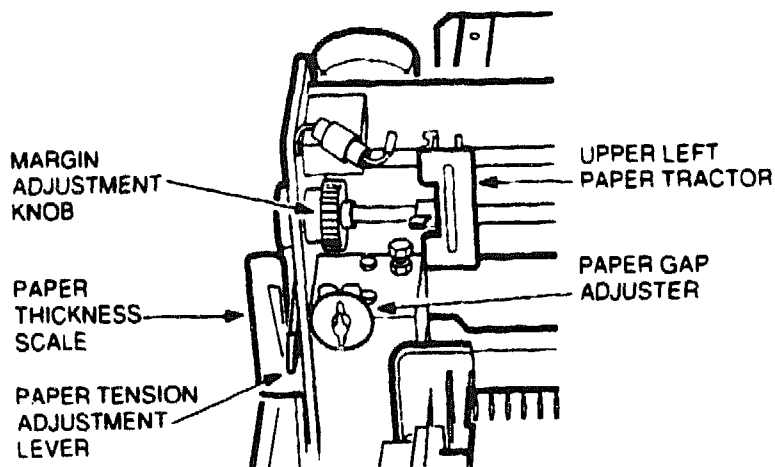
3.6 Paper Tension Lever

The paper tension lever adjusts the pressure that the paper tensioning fingers apply to the paper (see Figure 3-10). There is a PAPER THICKNESS scale, from 1 to 6, located next to the paper tension lever. The higher the number (the heavier the paper), the less the tension. A "1" is equivalent to 15-pound one-part paper. Adjust for the maximum tension without smearing the print.

3.7 Print Gap Control

The print gap control is a rotary adjustment that adjusts the distance between the paper and the print heads (see Figure 3-10). It has a scale from less than one to more than six, and should be nominally set to the same point on the scale as the PAPER THICKNESS scale. Adjust this and the paper tension lever to obtain the best print quality.

Figure 3-10: Paper Tension Lever, Print Gap Control, Margin Adjust



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3.8 Margin Adjust Knob

The margin adjust knob adjusts the horizontal position of the paper in the printer (see Figure 3-10).

Chapter 4

SETTING COMMUNICATIONS AND PRINT PARAMETERS

4.1 Introduction

This chapter defines the user settable parameters of the LG31 printer. There are two ways for setting parameters in the LG31. Some of the parameters can be set by either method.

There are eight categories of parameters in the LG31 printer listed in the configuration menu that are settable when you enter the program mode:

- Font - this contains six subcategories
- Lines Per Inch
- Forms Control
- Interface Control - this contains four subcategories
- Margin Settings
- Horizontal Tabs
- Vertical Tab Stops
- Printer Control Straps

When entering the program mode, you can select one or more of the categories for modification before exiting back to off-line.

There are two parameters and two sets of adjustments that can be made in the function mode. In the function mode, you can perform operations in one of the categories, and then you must exit to off-line. You can then begin the process again to perform operations in another category.

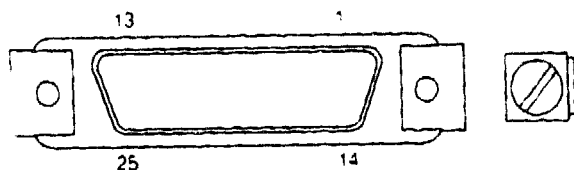
The process for listing the parameters in these categories and making changes to them is given in the following sections.

4.2 Interface Control—Host to Printer Interface

The LG31 printer contains an EIA RS-232-C 25-pin connector as a serial interface to the host. The connector is located on the lower back of the printer (see Figure 4-2). A 70-27717-01 cable is supplied to connect the host to the LG31 printer.

The RS-232-C signals and the associated pins on the interface connector are given in Table 4-1. The DIGITAL serial protocol is XON/XOFF (for a description of the XON/XOFF protocol, see the *LG31 Printer User's Guide*, EK-LG31C-UG).

Figure 4-1: Serial Interface Connector



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Figure 4-2: Location of the Serial Interface Connector

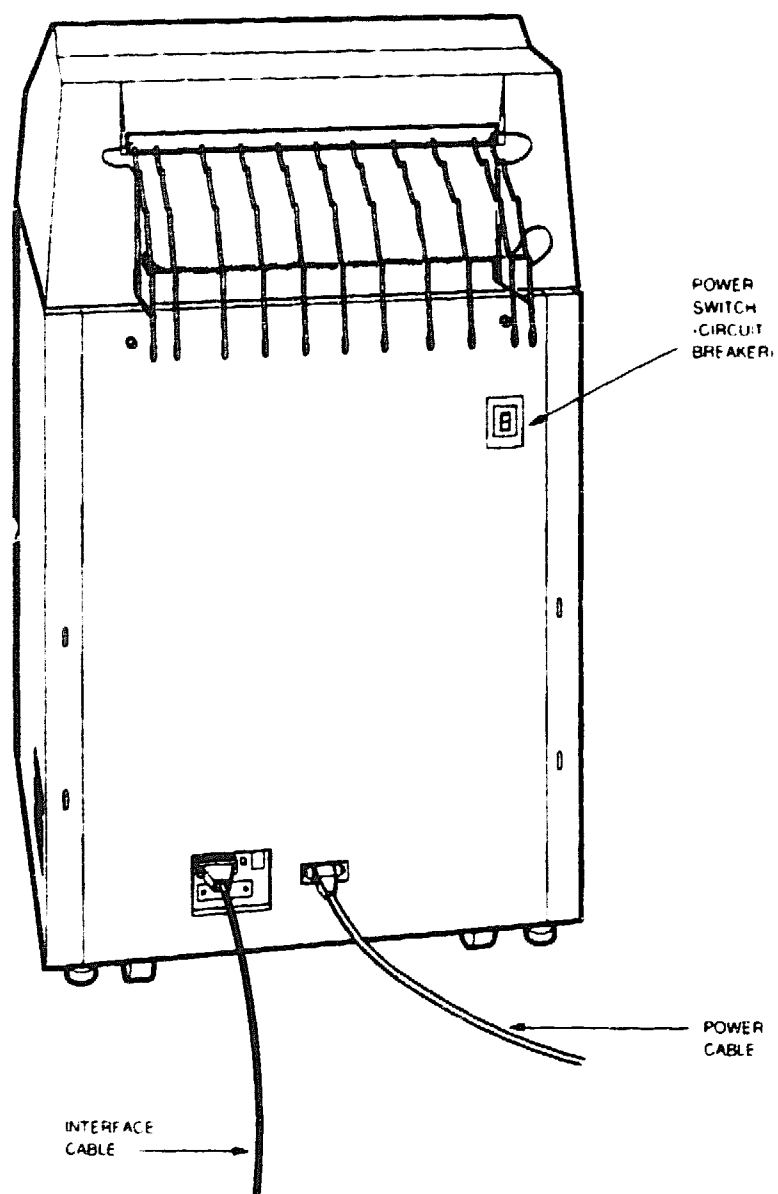


Table 4-1: Pin Assignments

Pin	Signal	Signal Direction	Description
1	AA Chassis Gnd	—	Frame (Protective) Ground
2	BA (TX) (See Note 2)	From Printer	Printer transmits coded Ready/Busy (DC1/DC3) or BREAK status (strap A5 IN). ETX/ACK — Up to 1500 characters will be accepted. ETX terminates the string. The printer sends an ACK to the host when transmission can resume.
3	BB (RX) (See Note 1)	To Printer	Printer can receive serial data from Data Source when ON LINE.
4	CA (RTS)	From Printer	Request to Send. If so strapped (A8 IN), printer is ON LINE when CA is ON. Straps affect use of CA signal: A8, A16, A24, A32.
5	CB (CTS) (See Notes 3 and 4)	To Printer	Clear to Send. Set by printer. Transmission is not inhibited and it can operate with the host. Printer is capable of transmitting if DC1/DC3 or BREAK protocol is used. If Serial Interface strap B4 is IN, the host may use CC to inhibit printer transmit.
6	CC (DSR) (See Note 3)	To Printer	Data Set Ready. When enabled by serial interface strap B4 IN), the lead may be used to inhibit printer transmitting, although it can still receive data.
7	OV (AB)	—	Printer Signal Ground.
11	SCA-1	From Printer	Secondary Request to Send. Permits printer status to be reflected in same manner as CA lead.
19	SCA-2	From Printer	Secondary Request to Send. Same as pin 11.

Table 4-1 (Cont.): Pin Assignments

Pin	Signal	Signal Direction	Description
20	CD (DTR)	From Printer	Data Terminal Ready. If so strapped (A7 IN), data terminal is turned ON by printer when a positive voltage level is applied to the pin 20 line, to indicate printer is ready to accept data. Straps affect use of CD signal: A7, A15, A23, A28. See Note 4.

NOTES

1. BB (RX) is the primary data input line. It is the line that carries the serial data from the data source to the printer. Data is accepted from this line as long as the printer is ON LINE, and for one second after the printer has gone to OFF LINE, to allow for line delays during satellite communication. A negative level is a mark, and a positive level is a space. When released, this line should be in "Mark" condition.
2. When using XON/XOFF, parity must be set to match the host.
3. CC is strap dependent, CB is not strap dependent. Regardless of how the printer is strapped, the host may always use CB to inhibit transmit.
4. CB must be positive or the lead open-circuit for DC1/DC3 protocol. For this protocol, CA or CD cannot be tied to CB.

4.3 Configuration Menu

4.3.1 Listing the Parameters

You can get a list of and change all of the user settable parameters by using the keys on the inner control panel. The nine categories of parameters are contained in the configuration menu. The subcategories are listed after you select the category. To get a copy of the configuration menu, perform the following:

1. Turn the printer power on. Open the top cover and pull the interlock switch plunger up to its highest point. This activates the inner control panel.
2. When the self-test completes and the display reads [O F L], press the (1) PRG key. The LG31 printer will print the configuration menu (see Figure 4-2).
3. To select a category of parameters, push the key with the category number shown on the configuration menu. To see the form control parameters, press (2). The LG31 will print a list of the form control parameters.
4. To select a parameter, press the key number shown next to the parameter.
5. To exit from the category back to the program mode, press the (0) key.
6. Press the (0) key to return to the configuration menu.
7. To return the printer to the off-line mode, press the (0) TEST CLR key.

Figure 4-3: Configuration Menu

THE PRESENT CONFIGURATION IS: (44A513016 SY - 44A513017 IM)
FIRMWARE REVISION LEVEL V1.31.000-CSS

1. Font:
Style - 44A513017 Dataprocessing
CPI - 10 CPI
Country - US ASCII
Mode - Normal
Horizontal Expansion - X1
Vertical Expansion - X1
2. LPI - 6 lpi
3. Forms Control (lines):
Form Length - 66
Top Margin - 01
Bottom Margin - 66
4. Interface Control:
Interface Type - Serial
Input buffer length 3840
Interface Straps A:
0 1 2 3
12345678901234567890123456789012
0000100000000100000000101000001000
Interface Straps B:
0 1 2 3
12345678901234567890123456789012
01000100000000000000000000000000
Speed - 9600
Parity - Even
5. Margin Settings (columns):
Left Margin - None
Right Margin - 132
6. Horizontal Tabs (columns):
009 017 025 033 041 049 057 065 073 081
089 097 105 113 121 129 137 145 153 161
169 177 185 193 201 209 217
7. Vertical Tab stops:
8. Printer Control Straps:
Printer Straps A:
0 1 2 3
12345678901234567890123456789012
00000000000000000000000010001110010
Printer Straps B:
0 1 2 3
12345678901234567890123456789012
00000000000000000000000000000000
Press the number '0' to return to normal operation.
To continue modification select (1-8).

4.3.2 Communications Parameters

Under the Interface Control category in the function mode, there are five subcategories:

1. Interface type — There is one interface type available (serial).
2. Interface A straps — There are 32 software straps that you can define as in or out. The straps and the parameters they enable/inhibit are listed in Table 4-2. The LG31 printer is shipped with four interface A straps enabled.

When you enter the interface strap A subcategory, the strap number is displayed in the left two digits (1-32) of the display panel. The right digit indicates whether the strap is in (i) or out (o). These straps control the RS-232-C signals.

3. Interface B straps — There are 32 software straps that you can define as in or out. The straps and the parameters they enable/inhibit are listed in Table 4-2.

When you enter the interface strap B subcategory, the strap number is displayed in the left two digits (33-64) of the display. The right digit indicates whether the strap is in (i) or out (o). These straps control the response of the LG31 to the host data.

4. Speed (baud rate) — There are nine baud rates to select from.
5. Parity — There are four parity options.

To select the interface control category of parameters (see Figure 4-2):

1. Place the printer off-line ([O F L] is displayed). If the printer is on-line ([O n L] is displayed), press the ON LINE key.
2. Press the PRG key ([P r o] is displayed). The LG31 printer prints the configuration menu.
3. Press key (4). The LG31 printer will print the interface control options available (see Figure 4-3).
4. To change one of the interface straps, press key (2). The printer will list the options available (see Figure 4-3). The interface straps and their present condition are listed in the configuration menu.
 - Press the (3) key until the number of the desired strap shows in the first two digits of the display.

- Press (1) to enable the strap (an "i" in the third digit on the display).
 - Press (2) to remove the strap (an "o" in the third digit on the display).
 - Press the (0) key and the printer will return to the configuration menu level ([P r o] is displayed).
5. Press key (4). The LG31 printer will print the interface control options available (see Figure 4-3).
 6. To change the speed (baud rate), press (4). The printer will list the available baud rates. The current baud rate is listed in the configuration menu.
 - Press the key which corresponds to the number of the baud rate in the list. Having selected the baud rate, the printer returns to the configuration menu ([P r o] is displayed).
 - Press the (0) key, and the printer will return to the configuration menu level ([P r o] is displayed).
 7. Press key (4). The LG31 printer will print the interface control options available (see Figure 4-4).
 8. To change the parity, press the (5) key. The LG31 printer will list the parity options (see Figure 4-5).
 - Press the key which corresponds to the number of the desired parity option. Having selected the baud rate, the printer returns to the configuration menu ([P r o] is displayed).
 - Press the (0) key, and the printer will return to the configuration menu level ([P r o] is displayed).
 9. Press the (0) key to exit the program mode.

There are no options available for interface type. The response of the LG31 printer to selecting interface is shown in Figure 4-6.

Figure 4-4: Interface Control Straps

Interface Control

- 0. Exit
- 1. Interface Type
- 2. Interface Straps A
- 3. Interface Straps B
- 4. Speed
- 5. Parity

Straps:

- 0. Exit
- 1. Strap in
- 2. Strap out
- 3. Forward without change
- 4. Reverse without change

Interface Straps A:

0	1	2	3
12345678901234567890123456789012			
0000100000000100000000101000000000			

Interface Straps B:

0	1	2	3
12345678901234567890123456789012			
11000100000000000000000000000000			

Press the number '0' to return to normal operation.
To continue modification select (1-8).

Figure 4-5: Interface Control Speed

Interface Control

- 0. Exit
- 1. Interface Type
- 2. Interface Straps A
- 3. Interface Straps B
- 4. Speed
- 5. Parity

Speed -

- 0. Exit
- 1. 110
- 2. 300
- 3. 600
- 4. 1200
- 5. 1800
- 6. 2400
- 7. 4800
- 8. 9600
- 9. 19200

Speed - 9600

Press the number '0' to return to normal operation.
To continue modification select (1-8).

Figure 4-6: Interface Control Parity

Interface Control

- 0. Exit
- 1. Interface Type
- 2. Interface Straps A
- 3. Interface Straps B
- 4. Speed
- 5. Parity

Parity -

- 0. Exit
- 1. Even
- 2. Odd
- 3. Space
- 4. Mark

Parity - Even

Press the number '0' to return to normal operation.
To continue modification select (1-8).

Note

The space and mark options are available in 7-bit mode only. In 8-bit mode, these options are not selectable and are not printed.

Figure 4-7: Interface Control Type

Interface Control

- 0. Exit
- 1. Interface Type
- 2. Interface Straps A
- 3. Interface Straps B
- 4. Speed
- 5. Parity

Interface Type

- 0. Exit
- 1. Serial

Interface Type - Serial

Press the number '0' to return to normal operation.
To continue modification select (1-8).

Table 4-2: Serial Interface Strapping Options

Strap Number	Action When In (In = 1; Out = 0)
READ/BUSY CONTROL	
A1	Not assigned
A2	Not assigned
A3	Not assigned
A4	Enable READY/BUSY status by means of SCA (pins 11 and 19)
A5	Enable READY/BUSY to cause transmission of XON/XOFF codes
A6	Enable READY/BUSY to cause transmission of a 200 msec BREAK
A7	Enable READY/BUSY to turn circuit CD (interface pin 20) ON or OFF
A8	Enable READY/BUSY to turn circuit CA (interface pin 4) ON or OFF
FAULT CONTROL	
A9	Not assigned
A10	Not assigned
A11	Not assigned
A12	Enable NO FAULT/FAULT status by means of SCA (pins 11 and 19)
A13	Enable NO FAULT/FAULT to cause transmission of XON/XOFF codes
A14	Enable NO FAULT/FAULT to cause transmission of a 200 msec BREAK
A15	Enable NO FAULT/FAULT to turn off circuit CD
A16	Enable NO FAULT/FAULT to turn off circuit CA
SELECT CONTROL	
A17	Not assigned
A18	Not assigned
A19	Not assigned
A20	Enable ON LINE/OFF LINE status by means of SCA (pins 11 and 19)
A21	Enable printer in OFF LINE to cause transmission of XON/XOFF codes
A22	Enable printer in OFF LINE to cause transmission of a 200 msec BREAK
A23	Enable printer in OFF LINE to turn off circuit CD
A24	Enable printer in OFF LINE to turn off circuit CA
A25	Not assigned

Table 4-2 (Cont.): Serial Interface Strapping Options

Strap Number	Action When In (In = 1; Out = 0)
A26	Enable transmission of an <ACK> on receipt of an <ETX>
A27	Reverse SCA polarity (active state LOW) if SCA is enabled
A28	Reverse DTR polarity (active state LOW) if DTR is enabled
A29	Inhibit received parity check
A30	Enable two stop bits
A31	Enable transmitter
OTHER	
A32	Reverse CA polarity (active state LOW) if CA is enabled
B1	Not assigned
B2	No parity bit transmitted/received
B3	Enable auto input buffer expansion
B4	Host may not use CC to inhibit transmit
B5	Replaces underline character with <CR>
B6	Seven and eight bit data accepted
B7-B32	Not assigned

NOTE

The configuration menu prints out strap status in serial interface in two rows A1-A32 and B1-B32. The LED display, however, shows 1 through 64 with 33-64 being equivalent to B1-B32.

4.4 Print Characteristics

The rest of the configuration entries control the form and location of the printed data.

4.4.1 Font

Under the font category in the program mode, there are six subcategories (see Figure 4-8):

1. Style - the quality/density of the printed characters
2. CPI - Characters Per Inch
3. Country
4. Mode (there are no font enhancements available through the control panel)

5. Horizontal Expansion

6. Vertical Expansion

To select the font category:

1. Place the printer off-line ([O F L] is displayed). If the printer is on-line ([O n L] is displayed), press the ON LINE key.
2. Press the PRG key ([P r o] is displayed). The LG31 printer will print the configuration menu.
3. Press the (1) key. The LG31 printer will list the font options (see Figure 4-8).
4. Press the key with the same number as the desired font option.
5. Follow the procedure in the related section as follows.

There are no mode options available. The response of the LG31 printer to mode selection is shown in Figure 4-8.

Figure 4-8: Font Menu

FONT:

0. Exit
1. Style
2. CPI
3. Country
4. Mode
5. Horizontal Expansion
6. Vertical Expansion

4.4.1.1 Style

Figure 4-9: Font Style

FONT:

- 0. Exit
- 1. Style
- 2. CPI
- 3. Country
- 4. Mode
- 5. Horizontal Expansion
- 6. Vertical Expansion

Style -

- 0. Exit
- 1. 44A513017 Dataprocessing
- 2. 44AXXXXXX Gothic NLQ
- 3. 44AXXXXXX OCR-A
- 4. 44AXXXXXX OCR-B

Style - 44A513017 Dataprocessing

Press the number '0' to return to normal operation.
To continue modification select (1-8).

To select the style subcategory of parameters (see Figure 4-9):

1. Place the printer off-line ([O F L] is displayed). If the printer is on-line ([O n L] is displayed), press the ON LINE key.
2. Press the PRG key ([P r o] is displayed). The LG31 printer will print the configuration menu.
3. Press the (1) key. The LG31 will print the list of print styles available.
4. Press the key with the same number as the desired style ((3) selects OCR-A).
5. Press the (0) key to return the LG31 printer to off-line operation ([O F L] is displayed).

4.4.1.2 CPI

Figure 4-10: Font CPI

FONT:

- 0. Exit
- 1. Style
- 2. CPI
- 3. Country
- 4. Mode
- 5. Horizontal Expansion
- 6. Vertical Expansion

CPI -

- 0. Exit
- 1. 5 CPI
- 2. 10 CPI
- 3. 12 CPI
- 4. 13.3 CPI
- 5. 15 CPI
- 6. 16.7 CPI
- 7. 6.67 CPI
- 8. 8.35 CPI

CPI - 10 CPI

Press the number '0' to return to normal operation.
To continue modification select (1-8).

To select the CPI subcategory of parameters (see Figure 4-10):

1. Place the printer off-line ([O F L] is displayed). If the printer is on-line ([O n L] is displayed), press the ON LINE key.
2. Press the PRG key ([P r o] is displayed). The LG31 printer will print the configuration menu.
3. Press the (2) key. The LG31 will print the list of CPI available.
4. Press the key with the same number as the desired CPI ((3) selects 12 CPI).
5. Press the (0) key to return the LG31 printer to off-line operation ([O F L] is displayed).

4.4.1.3 Country (Character Sets)

Figure 4-11: Font Country

FONT:

0. Exit
1. Style
2. CPI
3. Country
4. Mode
5. Horizontal Expansion
6. Vertical Expansion

Country -

0. Exit
1. USA (default)
2. Great Britain
3. DEC Dutch
4. DEC Finland
5. France
6. DEC French (Canada)
7. Germany
8. Italy
9. Continue

Country -

0. Exit
1. JIS Roman
2. DEC Norway/Denmark
3. Spain
4. DEC Sweden
5. DEC Swiss
6. ISO Norway/Denmark
7. DEC Portuguese

Country - US ASCII

Press the number '0' to return to normal operation.
To continue modification select (1-8).

To select the character set subcategory of parameters (see Figure 4-11):

1. Place the printer off-line ([O F L] is displayed). If the printer is on-line ([O n L] is displayed), press the ON LINE key.

2. Press the PRG key ([P r o] is displayed). The LG31 printer will print the configuration menu.
3. Press the (3) key. The LG31 will print a list of national replacement character sets available.
4. Press the key with the same number as the desired set ((3) selects Digital Dutch).
5. If the desired character set is not in the list, press the (9) key. The printer will list the rest of the character sets available. Perform step 4.
6. Press the (0) key to return the LG31 printer to off-line operation ([O F L] is displayed).

4.4.1.4 Mode

Figure 4-12: Font Mode

FONT:

0. Exit
1. Style
2. CPI
3. Country
4. Mode
5. Horizontal Expansion
6. Vertical Expansion

Mode -

Cannot change character attributes from the menu

0. Exit

Mode - Normal

Press the number '0' to return to normal operation.

To continue modification select (1-8).

The character attributes cannot be changed from the configuration menu.

4.4.1.5 Horizontal Expansion

Figure 4-13: Font Horizontal Expansion

FONT:

- 0. Exit
- 1. Style
- 2. CPI
- 3. Country
- 4. Mode
- 5. Horizontal Expansion
- 6. Vertical Expansion

Horizontal Expansion -

- 0. Exit
- 1. X1
- 2. X2

Horizontal Expansion - X1

Press the number '0' to return to normal operation.
To continue modification select (1-8).

To select the horizontal expansion subcategory of parameters (see Figure 4-13):

1. Place the printer off-line ([O F L] is displayed). If the printer is on-line ([O n L] is displayed), press the ON LINE key.
2. Press the PRG key ([P r o] is displayed). The LG31 printer will print the configuration menu.
3. Press the (5) key. The LG31 will print the list of horizontal expansions available.
4. Press the key with the same number as the desired expansion ((2) selects the times two expansion).
5. Press the (0) key to return the LG31 printer to off-line operation ([O F L] is displayed).

4.4.1.6 Vertical Expansion

Figure 4-14: Font Vertical Expansion

FONT:

- 0. Exit
- 1. Style
- 2. CPI
- 3. Country
- 4. Mode
- 5. Horizontal Expansion
- 6. Vertical Expansion

Vertical Expansion -

- 0. Exit
- 1. X1
- 2. X2
- 3. X3

Vertical Expansion - X1

Press the number '0' to return to normal operation.
To continue modification select (1-8).

To select the vertical expansion subcategory of parameters (see Figure 4-14):

1. Place the printer off-line ([O F L] is displayed). If the printer is on-line ([O n L] is displayed), press the ON LINE key.
2. Press the PRG key ([P r o] is displayed). The LG31 printer will print the configuration menu.
3. Press the (6) key. The LG31 will print the list of vertical expansions available.
4. Press the key with the same number as the desired expansion ((3) selects the times three vertical expansion).
5. Press the (0) key to return the LG31 printer to off-line operation ([O F L] is displayed).

4.4.2 LPI

Figure 4-15: Lines Per Inch

LPI -

- 0. Exit
- 1. 6 lpi
- 2. 8 lpi
- 3. 10 lpi
- 4. 12 lpi
- 5. 2 lpi
- 6. 3 lpi
- 7. 4 lpi

LPI - 6 lpi

Press the number '0' to return to normal operation.
To continue modification select (1-8).

To select the LPI subcategory of parameters (see Figure 4-15):

1. Place the printer off-line ([O F L] is displayed). If the printer is on-line ([O n L] is displayed), press the ON LINE key.
2. Press the PRG key ([P r o] is displayed). The LG31 printer will print the configuration menu.
3. Press the (2) key. The LG31 printer will list the LPI options (see Figure 4-15).
4. Press the key with the same number as the desired LPI option ((3) is 10 lines per inch).
5. Press the (0) key to return the LG31 printer to off-line operation ([O F L] is displayed).

4.4.3 Forms Control

Setting the forms control (see Figure 4-16) differs from the other printing characteristic setups in that you normally perform a sequence of settings, and that the last setting exits back to the configuration menu. There are two methods for setting the form dimension and position. One is to select the function mode (see Section 4.5.2), and the other is to select forms control from the program mode.

Figure 4-16: Forms Control

Form Control:

0. Exit
1. Form Feed
2. Line Feed (forward)
3. Line Feed (reverse)
4. Set Top of Form
5. Set Top Margin
6. Set Bottom Margin
7. Set Bottom of Form
8. 1/72 inch Paper Forward
9. 1/72 inch Paper Reverse

Forms Control (lines):

Form Length - 66
Top Margin - 01
Bottom Margin - 66

Press the number '0' to return to normal operation.
To continue modification select (1-8).

To select the forms control category in the program mode:

1. Place the printer off-line ([O F L] is displayed). If the printer is on-line ([O n L] is displayed), press the ON LINE key.
2. Press the PRG key ([P r o] is displayed). The LG31 printer will print the configuration menu.
3. Press the (3) key. The LG31 printer will list the forms control options (see Figure 4-14).
4. Press and hold the (2) key until the top of the sheet aligns with the notches in the upper tractors.
5. Press the (4) key to start the line count. The display is [0 0 0].
6. Press and hold the (2) key until you reach the desired top margin. The display reads the number of lines the paper moves forward (9 lines equals 1½ inches).
7. Press the (5) key to set the top margin.
8. Press and hold the (2) key until you reach the desired bottom margin. The display reads the number of lines the paper moves forward (51 lines equals 8½ inches). The display reads [6 0] 9+51.
9. Press the (6) key to set the bottom margin.

10. Press and hold the (2) key until you reach the bottom of the form (66 for 11-inch paper).
11. Press the (7) key to set the bottom of the form and to return to the configuration menu.
12. Press the (0) key to return the LG31 printer to off-line operation ([O F L] is displayed).

4.4.4 Margin Settings

Figure 4-17: Margin Settings

Margin Settings:

0. Exit
1. Advance Left
2. Advance Right
3. Set Left Margin
4. Set Right Margin
5. Clear Margins
6. Display Current Right Margin
7. Display Current Left Margin
8. Display Current Position

Margin Settings (columns):

Left Margin - None
Right Margin - 132

Press the number '0' to return to normal operation.
To continue modification select (1-8).

You can set the margin settings from either the function mode (see Section 4.5.5) or the program mode, to select the margin settings category in the program mode:

1. Place the printer off-line ([O F L] is displayed). If the printer is on-line ([O n L] is displayed), press the ON LINE key.
2. Press the PRG key ([P r o] is displayed). The LG31 printer will print the configuration menu.
3. Press the (5) key. The LG31 printer will list the margin setting options (see Figure 4-17).
4. Press the (6) key to display the left margin setting.

5. Press the (2) key until the display reads the column number you want for a left margin.
6. Press the (3) key to set the left margin.
7. Press the (7) key to display the right margin setting.
8. Press the (1) key until the display reads the column number you want for a right margin.
9. Press the (4) key to set the right margin.
10. Press the (0) key to return to the configuration menu.
11. Press the (0) key to return the LG31 printer to off-line operation ([O F L] is displayed).

The (5) key sets the margins to the default values, and the (8) key displays the current column position.

4.4.5 Horizontal Tab Stops

The horizontal tabs cannot be set from the configuration menu. The response of the LG31 printer to a horizontal tab entry is shown in Figure 4-18.

Figure 4-18: Horizontal Tab Stops

Horizontal Tab Stops:

Cannot set horizontal tabs from the menu

0. Exit

Horizontal Tabs (columns):

009	017	025	033	041	049	057	065	073	081
089	097	105	113	121	129	137	145	153	161
169	177	185	193	201	209	217			

Press the number '0' to return to normal operation.
To continue modification select (1-8).

Figure 4–19: Vertical Tab Stops

Vertical Tab Stops:

Cannot set vertical tabs from the menu

0. Exit

Vertical Tab Stops:

Press the number '0' to return to normal operation.

To continue modification select (1-8).

4.4.6 Vertical Tab Stops

The vertical tab stops cannot be set from the configuration menu. The response of the LG31 printer to a vertical tab stops entry is shown in Figure 4–19.

4.4.7 Printer Control Straps

There are 64 printer control straps in the LG31 printer. These straps control how the LG31 responds when printing data. For a detailed description of these straps, see Chapter 2, Section 2.2 in the *LG31 User's Guide* (EK-LG31C-UG).

1. **Printer Control Straps (A)** — There are 32 A software straps that you can define as in or out. When you enter the interface strap A sub-category, the strap number is displayed in the left two digits (1-32) of the display panel. The right digit indicates whether the strap is in (i) or out (o).
2. **Printer Control Straps (B)** — There are 32 B software straps that you can define as in or out. When you enter the interface strap B sub-category, the strap number is displayed in the left two digits (33-64) of the display. The right digit indicates whether the strap is in (i) or out (o).

To select the printer control category of parameters (see Figure 4–20).

1. Place the printer off-line ([O F L] is displayed). If the printer is on-line ([O n L] is displayed), press the ON LINE key.
2. Press the PRG key ([P r o] is displayed). The LG31 printer will print the configuration menu.

Figure 4-20: Printer Control Straps — Factory Setting

Printer Control Straps:

- 0. Exit
- 1. Printer Straps A
- 2. Printer Straps B

Straps:

- 0. Exit
- 1. Strap in
- 2. Strap out
- 3. Forward without change
- 4. Reverse without change

Printer Control Straps:

Printer Straps A:

0	1	2	3
12345678901234567890123456789012			
000000000000000000000100001110010			

Printer Straps B:

0	1	2	3
12345678901234567890123456789012			
00000000000000000000000000000000			

Press the number '0' to return to normal operation.
To continue modification select (1-8).

End of Program Mode

- 3. Press key (8). The printer will list the options available (see Figure 4-20). The interface straps and their present condition are listed in the configuration menu.
- 4. Press the (3) key until the number of the desired strap shows in the display.
- 5. Press (1) to enable the strap (an "i" on the display).
- 6. Press (2) to disable the strap (an "o" on the display).
- 7. Press the (0) key and the printer will return to the printer control category.
- 8. Press the (0) key to return to the configuration menu.
- 9. Press the (0) key and the LG31 printer will return to off-line operation ([O F L] is displayed).

4.5 Function Mode

In the function mode (see Figure 4-21), you can perform the following:

- Printer initialization
- Forms setup
- Print adjustment
- Forms adjustment
- Margin setup
- Reverse form feed
- Buffer clear

Unlike operations in the programming mode, you can perform operations in one of the characteristics for entry into the function mode. A menu is not available to lead you through the modification process. The procedures for performing these operations are contained in the following sections.

4.5.1 Printer Initialization

There are two ways to initialize the LG31 printer:

1. Through the control panel.
2. Through the initialization switch.

It may be necessary to perform the initialization procedure if the printer becomes locked, or if you want to return to the factory settings. Table 4-3 describes how to use the control panel to initialize the LG31 printer. Table 4-4 describes how to initialize the printer using the initialization switch.

Figure 4-21: Function Mode

THE PRESENT CONFIGURATION IS: (44A513016 SY - 44A513107 IM)
FIRMWARE REVISION LEVEL V1.31.000-CSS

1. Font:
Style - 44A513017 Dataprocessing
CPI - 10 CPI
Country - US ASCII
Mode - Normal
Horizontal Expansion - X1
Vertical Expansion - X1
 2. LPI - 6 lpi
 3. Forms Control (lines):
Form Length - 66
Top Margin - 01
Bottom Margin - 66
 4. Interface Control:
Interface Type - Serial
Input buffer length 3840
Interface Straps A:
0 1 2 3
12345678901234567890123456789012
00001000000010000000101000001000
Interface Straps B:
0 1 2 3
12345678901234567890123456789012
01000100000000000000000000000000
Speed - 9600
Parity - Even
 5. Margin Settings (columns):
Left Margin - None
Right Margin - 132
 6. Horizontal Tabs (columns):
009 017 025 033 041 049 057 065 073 081
089 097 105 113 121 129 137 145 153 161
169 177 185 193 201 209 217
 7. Vertical Tab stops:
 8. Printer Control Straps:
Printer Straps A:
0 1 2 3
12345678901234567890123456789012
00000000000000000000000000000000
Printer Straps B:
0 1 2 3
12345678901234567890123456789012
00000000000000000000000000000000
- Press the number '0' to return to normal operation.
To continue modification select (1-8).

Table 4-3: Initialization Procedure

Action	Results	Display
Press (3) ON LINE	Printer set to off-line.	[O F L]
Press (9) FCT	Printer enters Mode Selection mode.	[.F n c]
Press (1) PRG	Printer enters Initialization mode.	[. s u]
Select one:		
Press (0) TEST CLR	Returns to off-line without any changes.	[O F L]
or		
(3) ON LINE	Resets the printer parameters to their respective Reset State.	[.C S U] [.8.8.8] [i P] [.8.8.8] [O F L]
(9) FCT	To initialize printer configuration to default conditions.	[.IS. U] [.8.8.8] [i P] [.8.8.8] [O F L]

NOTE

A user's configuration menu selections are reset to factory settings as a result of a defective battery or unintentional operation of the initialization switch on the inner control panel.

Table 4-4: Lock-Up Printer Initialization Procedure

Action	Results
Turn printer power OFF.	Printer disabled.
Slide the printer initialization switch to its opposite position (Switch located at top of inner control panel).	
Turn printer power ON.	Printer enabled.
When display indicates [. S U], press (9) FCT.	Initializes the printer to factory settings (see Figure 4-2 printout.)
When display indicates [. S U], slide the printer initialization switch back to its original position.	Completes the initialization procedure.

NOTE

If the switch is not returned to its original position, the [. S U] display will reappear at next power-up or self-test procedure. The procedure can be repeated if necessary.

4.5.2 Forms Setup

Use form setup to establish top and bottom of form and top and bottom margin settings without causing any printing action to occur. Minimum form length is one line. Maximum form length is 559 mm (22.0 in). The Form Setup procedure is shown in Table 4-5.

CAUTION

Although the entire length of the form is available for printing, top and bottom margins are recommended in order to avoid printing on paper perforations and print wire snagging.

Prior to pressing key (4) LINE FEED, press any paper motion key to advance paper as appropriate, and the display will not change. After pressing key (4) LINE FEED, the display will change to a counter that will count the line feeds forward as key (2) FORM FEED is pressed or backwards, as key (3) ON LINE is pressed. However, the paper will not move again until key (7) FONT LINE FEED is pressed to set bottom of form. The top of form is actually set when key (4) LINE FEED is pressed. At this point, the 0.23 cm (1/72 inch) paper control keys (8) SET TOF and (9) FCT are disabled. Also, key (2) FORM FEED cannot be enabled because it is being used to increment line feed counts without moving

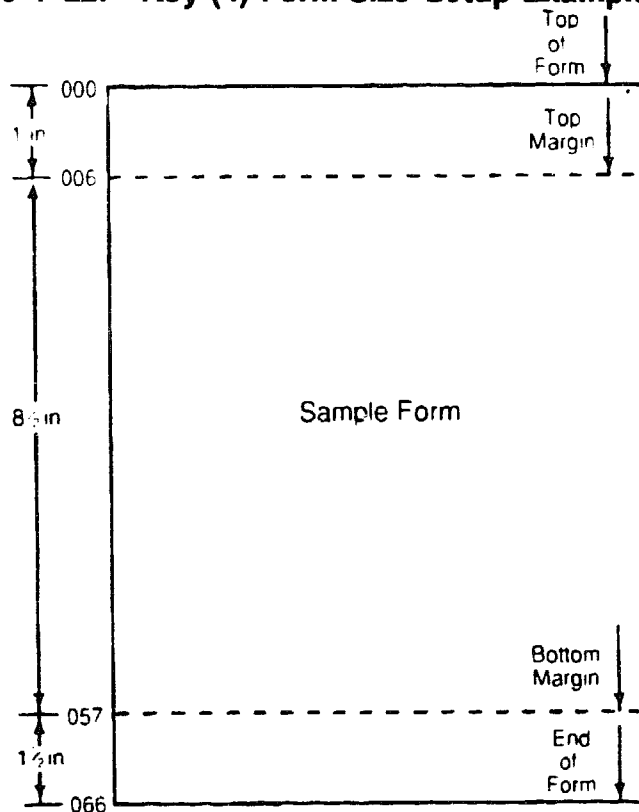
the paper. Pressing the bottom of form key (7) FONT will cause the form parameters entered to be saved, move the paper to align the top of the next form with the print line, and exit the Form Setup mode.

Table 4-5: Forms Setup Procedure

Action	Results	Display
Press (3) ON LINE	Printer goes to OFF LINE.	[O F L]
Press (9) FCT	Printer enters Mode Selection state.	[.F n c]
Press (2) FORM FEED	Printer enters Form Setup mode.	[F S U]
At this point, the choices are:		
(0) TEST CLR	Exits from Form Setup to OFF LINE, and feeds to top of next form in accordance with current length.	[O F L]
(1) PRG	Form feeds one form length.	[F S U]
(2) FORM FEED	Forward line feed in accordance with current LPI setting. If pressed and held for more than one second, consecutive line feeds occur at the rate of one each 0.5 of a second.	[F S U]
(3) ON LINE	Reverse line feed in accordance with current LPI setting. If pressed and held down for one second, consecutive paper reverse line feed steps occur at the rate of one each 0.5 of a second.	[F S U]
(4) LINE FEED	Sets top of form.	[0 0 1]
(5) CPI LPI	Sets top margin.	[0 0 4]
(6) PAPER REV	Sets bottom margin.	[0 6 2]
(7) FONT	Sets bottom of form and returns to OFF LINE.	[0 6 6]
(8) SET TOF	Advances paper 0.23 cm (1/72 inch).	[.F S U]
(9) FCT	Moves paper 0.23 cm (1/72 inch) in reverse direction.	[.F S U]

4.5.2.1 Top Of Form (TOF)

Figure 4-22: Key (4) Form Size Setup Example



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Figure 4-22 shows the same form size when Top Of Form (TOF) is set by using key (4) LINE FEED while the printer is in the Form Setup mode. In performing the following TOF set procedure, it is assumed that the Form Setup mode has already been entered, but key (4) LINE FEED has not been pressed and that the printer is set for 6 LPI.

Top Of Form (TOF) Set Procedure

1. Press key (2) FORM FEED again, and hold down to move the first line of the form, even (level) with the print line location. Top of paper line feeds to desired TOF, even with notches in upper tractor doors. Display remains [.F S U].

2. Press key (4) LINE FEED to set top of form. Display is [0 0 0].
3. One-inch top margin is desired at 6 LPI. Press and hold (2) FORM FEED, count six lines, release pushbutton. Display counts one line feed per half-second. Final display is [.0 0 6].
4. Press key (5) CPI/LPI to set top margin. Display remains at [.0 0 6].
5. The body of the form is 21.6 cm (8½ inches) or 51 lines. Press and hold key (2) FORM FEED, count 51 lines (51 + 6 = 57 total), release pushbutton. Display counts to [.0 5 7] and stops.
6. Press key (6) PAPER REV to set bottom margin. Display remains at [.0 5 7].
7. Form is 27.9 cm (11 in) or 66 lines. Press and hold key (2) FORM FEED, count nine lines, release pushbutton. Display is [.0 6 6].
8. Press key (7) FONT to set bottom of form, save form setup, form feed to first print line of next form, and exit Form Setup. Paper moves forward to first print line of next form. Display is [O F L].

During steps 3, 5, or 7 in the above TOF set procedure, if the counter goes beyond the desired number of lines, press key (3) ON LINE to subtract excess lines from the display counter.

NOTES

1. When a new supply of forms is needed and the same form is used, it is only necessary to align the top perforation with the notches in the paper locking levers (upper tractors) and press keys (0) TEST CLR and (8) SET TOF to set the top of form position. The form will move forward to place the first line of the next form in a printable position. Do not use key (4) LINE FEED for this purpose. Press key (3) ON LINE to resume printing.
2. After the form parameters have been entered by pressing key (7) FONT, changing the vertical pitch will not change form length. Example: changing from 6 to 8 LPI on a 27.9 cm (11 inches) page will not shorten page to 21.0 cm (8¼ inches) or 66 lines/8 LPI=8¼ inches.
3. See Table 4-6 for procedure to adjust form up or down.

4.5.3 Print Adjustment

The Print Adjustment procedure shown in Table 4-6 is used to review the print by observing several print patterns that may be selected. Except for the test pattern, printing starts when key is momentarily pressed, and continues printing until key (9) FCT is momentarily pressed. If key (9) (FCT) is pressed again before another key, the previous pattern is repeated. Further information and sample test pattern printouts are in Chapter 7 of the *LG31 Technical Manual*.

The print review function permits evaluation of the print alignment for proper character formation and graphics printing. If the adjustment is not satisfactory, call Digital.

CAUTION

This print quality adjustment should only be performed by a qualified technician.

Table 4-6: Print Review Procedure

Action	Results	Display
Press (3) ON LINE	Printer goes to off-line.	[O F L]
Press (9) FCT	Printer enters Function Selection mode.	[F n c]
Press (3) ON LINE	Printer enters Alignment mode. Cancels any existing special print modes.	[A d j]
At this point, the options are:		
(0) TEST CLR	Exits from Adjustment to off-line and restores previous menu configuration.	[O F L]
(1) PRG	Prints short segments of the various test patterns. Print width is governed by the number of columns in the current configuration. Software release number, model number, space for printer serial number, and date precede the test pattern printout.	[. 5 9]
(2) FORM FEED	Executes Form Feed.	[. 5 9]
(3) ON LINE	Prints amplitude pattern	[A . PL]
(4) LINE FEED	Executes Line Feed.	[A . PL]

Table 4-6 (Cont.): Print Review Procedure

Action	Results	Display
(5) CPI LPI*	Prints horizontal timing patterns	[.H E P]
(6) PAPER*	Prints vertical timing pattern	[.U E P]
(7) FONT*	Prints intermodule gap pattern	[. 9 P]
(8) SET TOF*	Prints checkerboard pattern	[.c b P]

*Indicates a continuous printing pattern. Press key (9) to stop printing. Press key (9) again to restart the most recently selected pattern.

4.5.4 Forms Adjustment

The Forms Adjustment procedure allows movement of the current form up or down on the paper after the form parameters are set by TOF Set procedure, using the Forms Control item 3 in the Configuration Menu (see Chapter 3).

Moving paper forward causes the current top of form to be displaced downward on the paper; moving the paper in the reverse direction causes the form to be moved upward on the paper. The form limits and Top Of Form using the paper tractor locking lever notch should already have been set prior to using the Forms Adjustment procedure in Table 4-7. Adjusting the form locations on the paper does not alter the current form parameters (margins, length).

Table 4-7: Forms Adjustment Procedure

Action	Results	Display
Press (3) ON LINE	Printer goes off-line.	[O F L]
Press (9) FCT	Printer enters Mode Selection mode.	[.F n c]
Press (4) LINE FEED	Printer enters Forms Adjustment mode.	[.F A d]

At this point, the choices are:

(0) TEST CLR	Exits from Forms Adjustment to OFF LINE and feeds to top of next form in accordance with current length.	[O F L]
(1) PRG	Prints rotating test pattern (see NOTE).	[.F A d]
(4) LINE FEED	Advances paper 0.23 cm (1/72 inch).	[.F A d]
(6) PAPER REV	Moves paper 0.23 cm (1/72 inch) in reverse direction.	[.F A d]

NOTE

The pattern begins and continues when key (1) PRG is pressed and held. The pattern stops when the key (1) PRG is released. The Forms Adjustment mode is still active after printing the test pattern.

4.5.5 Margin Setup

The Margin Setup procedure shown in Table 4-8 is used to set and display left and right margins.

Table 4-8: Margin Setup Procedure

Action	Results	Display
Press (3) ON LINE	Printer goes OFF LINE.	[O F L]
Press (9) FCT	Printer enters Mode Selection mode.	[F n c]
Press (5) CPI	Printer enters Margin Setup mode.	[L r S]
At this point, the options are:		
(0) TEST CLR	Exits from Margin Setup to OFF LINE.	[O F L]
(1) PRG	Counts column position to the left.	[.1 3 2] to [.0 0 0]
(2) FORM FEED	Counts column position to the right.	[.0 0 0] to [.1 3 2]
(3) ON LINE	Sets left margin.	[.0 0 0] Factory Setting
(4) LINE FEED	Sets right margin.	[.1 3 2] Factory Setting
(5) CPI LPI	Clears margin to default values (000 and 132 for 10 CPI). Also see Margin vs. Character Pitch procedure below.	[L r S]
(6) PAPER REV	Displays current right margin.	[.1 3 2]
(7) FONT	Displays current left margin.	[.0 0 0]
(8) SET TOF	Displays current column position.	[.0 0 0]

NOTE

The display examples given for keys (1) through (8) assume the printer is set for 10 CPI.

The following example explains how to select and set desired margins.

NOTE

A counter is used to indicate the current column number counted from the left margin. The count increments or decrements at the rate of two per second when key (1) PRG or (2) FORM FEED is held down. The maximum column counts are:

66 for 5 CPI	88 for 6.67 CPI	110 for 8.35 CPI
132 for 10 CPI	158 for 12 CPI	176 for 13.3 CPI
198 for 15 CPI	220 for 1 CPI	

Example (Margin Setup)

1. To move both margins inward five columns while printing at 10 CPI, press key (7) FONT to display left margin. Display is [.0 0 0].
2. Press and hold key (2) FORM FEED for five column counts and release. Display increases to [.0 0 5] and stops.
3. Press key (3) ON LINE to set left margin. Display remains at [.0 0 5].

NOTE

The column displayed is one less than the column in which printing will begin.

4. Press key (6) PAPER REV to display right margin. Display is [.1 3 2].
5. Press and hold key (1) PRG for five column counts and release. Display decreases from 132 to [.1 2 7] and stops.
6. Press key (4) LINE FEED to set right margin. Display remains at [.1 2 7].

NOTE

The last print column is the one displayed.

7. Press key (0) TEST CLEAR to return to Off Line from Margin Setup. Display is [O F L].

Note

In the above example, the print line is 122 columns wide. Printing is allowable in columns 6 through 127.

The left margin specifies the first printable position on a line, while the right margin specifies the last printable position on a line. The active position may not be placed outside the left and right margins. The left margin must be one less than the right margin.

If the active position is less than the left margin, the active position is set to the left margin.

If Autowrap is enabled and the active position is greater than the right margin, the next printable character will cause a carriage return/line feed before this character is printed. If Autowrap is disabled (truncated), any following characters will be ignored until the cursor is brought to within the printable area.

These margins are defined as hard margins, since printing is not permitted outside them. The only exception to this rule for vector drawing. The vector sequence is capable of drawing outside the margins.

When character pitch is changed and the same physical margins are desired, it is necessary to reset the margins before any data is sent. Changing the horizontal pitch resets left and right margins to the printable limits (column 1 and the rightmost position).

4.5.6 Reverse Form Feed

Use the Reverse Form Feed procedure shown in Table 4-9 to back the paper up one form's length for every press of the key.

Table 4-9: Reverse Form Feed Procedure

Action	Results	Display
Press (3) ON LINE	Printer goes to off-line.	[O F L]
Press (9) FCT	Printer enters Function mode.	[.F n c]
Press (6) PAPER REV	Printer enters Reverse Form Feed mode.	[.r F F]
At this point, the options are:		
(0) TEST CLR	Exits from Reverse Form Feed to off-line.	[O F L]
(6) PAPER REV	Turns paper back one form length each time the key is pressed.	[.r F F]

4.5.7 Buffer Clear

Use the Buffer Clear procedure shown in Table 4-10 to clear the contents in the printer's buffer.

Table 4-10: Buffer Clear Procedure

Action	Results	Display
Press (3) ON LINE	Printer goes off-line.	[O F L]
Press (9) FCT	Printer enters Function mode.	[.F n c]
Press (7) FONT	Printer enters Buffer Clear mode.	[O F L]
At this point, the options are:		
(0) TEST CLR	Exits from Buffer Clear to off-line.	[O F L]
(7) FONT	All information in the printer's buffer is cleared.	[C L r]

Chapter 5

PRINTER DIAGNOSTICS

5.1 Introduction

This chapter describes the LG31 self-tests and the alignment tests.

5.2 Self-Tests

The printer automatically verifies its operational integrity by performing the power-up self-tests on power-up. Thereafter, it continually performs the operational self-tests. In addition to these tests, the operator can invoke the printing self-tests.

5.2.1 Power-Up Self-Tests

The LG31 printer automatically self-tests upon power-up, and includes the following diagnostic tests:

- ROM checksum test to verify all bits of ROM.
- RAM pattern test to exercise and verify all bits of RAM.

Additionally, further self-test operations can be programmed into the printer to check internal logic at power-up with detected faults displayed at the control panel (see the *LG31 Printer User's Guide*, EK-LG31C-UG). A list of all messages displayed on the LEDs is contained in Appendix A.

5.2.2 Printing Self-Test

The LG31 printer can execute a printing self-test from either the outer or inner control panel. This test prints the 94 printable characters of the ASCII character set in the data processing font, at 10 CPI, and 6 LPI. The test is printed in a swirl pattern over the maximum printable width (see Figure 5-1). Faults are displayed at the control panel. Table 5-1 contains the procedure for an off-line print test. Appendix A lists the diagnostic fault codes.

Figure 5-1: ASCII Print Test Pattern - Sample Printout

```
!"#$%&'()*+,-./0123456789:;<=>?@ABCDEFGHIJKLMN O PQRSTUVWXYZ[\]^_`
!"#$%&'()*+,-./0123456789:;<=>?@ABCDEFGHIJKLMN O PQRSTUVWXYZ[\]^_`
!"#$%&'()*+,-./0123456789:;<=>?@ABCDEFGHIJKLMN O PQRSTUVWXYZ[\]^_`a
#$%&'()*+,-./0123456789:;<=>?@ABCDEFGHIJKLMN O PQRSTUVWXYZ[\]^_`ab
$%&'()*+,-./0123456789:;<=>?@ABCDEFGHIJKLMN O PQRSTUVWXYZ[\]^_`abc
%&'()*+,-./0123456789:;<=>?@ABCDEFGHIJKLMN O PQRSTUVWXYZ[\]^_`abcd
&'()*+,-./0123456789:;<=>?@ABCDEFGHIJKLMN O PQRSTUVWXYZ[\]^_`abcde
'()*+,-./0123456789:;<=>?@ABCDEFGHIJKLMN O PQRSTUVWXYZ[\]^_`abcdef
```

5.2.3 Operational Self-Test

The LG31 printer performs operational self-test diagnostics at regular intervals during normal operation. Any detected faults are displayed on the control panel.

5.2.4 Diagnostic fault codes

Appendix contains a list of the diagnostic fault codes and the faults they indicate. These displays can be initiated at:

- Power-up
- Emulation change
- Following a test pattern
- Initialization

Table 5-1: Print Test and Diagnostic Self-Test Procedure

Action	Result
Press (3) ON LINE key to put the printer off-line	Control panel display [O F L].
Press (0) TEST CLR key	Printer prints test pattern (see Chapter 4, Figure 4-20). Printing of test pattern ends and printer performs diagnostic self-test (maximum time: 10 seconds). This is the same test performed each time power is applied.
Press (0) TEST CLR key again	[.8.8.8] is displayed and audio alarm sounds, then [i p] is displayed for several seconds as the self-test is executed. [.8.8.8] is displayed again. If no faults are found, [O F L] is displayed. If a fault is detected, the appropriate fault code is displayed (refer to Chapter 5, Table 5-2). The first fault detected is displayed.

Key: [] = indicates three-character LED display.

5.3 Alignment Tests

There are a series of printing test patterns that are used for aligning the printer. While the alignment is to be performed by service personnel, the test patterns can be printed by all users.

- Enter the function mode (key (9) FCT).
- Enter print adjustment (key (3) ON LINE).
- Press key 1, 3, or 5 through 9 to select a pattern.
- Press key 0 to exit to local.

Chapter 6

PRINTER OPERATION

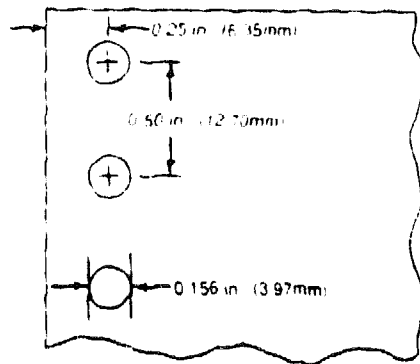
6.1 Introduction

This chapter provides information on the operation of the LG31 printer and includes descriptions of the control panels/display, power-up procedure, troubleshooting, and operator-correctable faults.

6.2 Loading Paper

The printer uses edged-punched (sprocket fed) fan-fold paper conforming to the dimensions shown in Figure 6-1.

Figure 6-1: Sprocket Hole Dimensioning Diagram



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To load paper in the LG31, carry out the following steps.

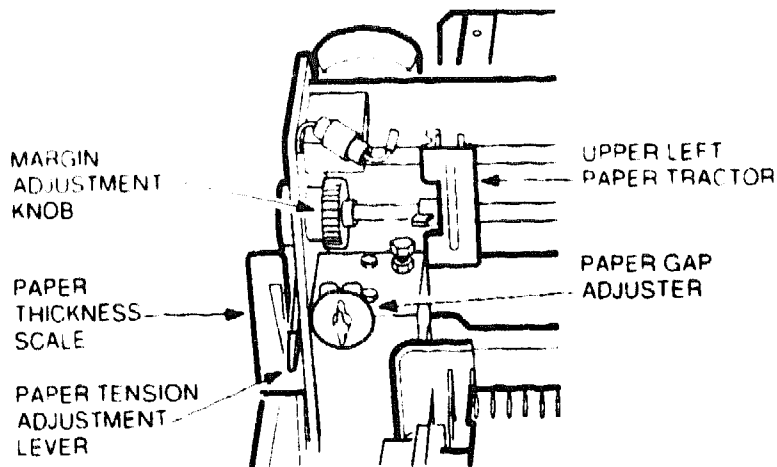
1. Open top cover.
2. Turn Paper Gap Adjuster to Load position (maximum clockwise). See Figure 6-2.
3. Open Paper Tension Adjust lever to position 1 (fully downward).

CAUTION

For initial paper loading, use 377.8 mm (14 7/8 in) wide or wider paper to avoid possibility of printing on striker bar and possible damage to actuator wires.

4. Open printer front door.
5. Cut top from box of fan-fold paper to avoid snagging of paper as it is fed to tractors. Place box of paper on shelf as shown in Figure 6-3.
6. Open upper paper tractor covers. Hand feed paper up through printer behind paper tensioning adjustment fingers as shown in Figure 6-3. Load paper evenly on upper tractor pins until the top edge of the paper is below the notches on the tractors.

Figure 6-2: Paper Loading Diagram



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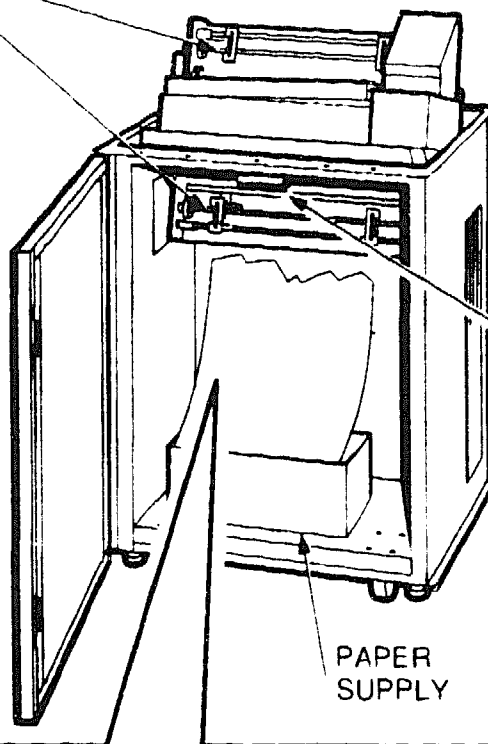
CAUTION

Do not attempt to move paper manually by turning pulleys or belts (pin feed de-synchronization/gear damage may result).

7. If necessary, release locking lever on right tractor by flipping lever upward and slide tractor horizontally to match paper width.
8. Close tractor covers. Slide right tractor slightly to the right to tension paper. Lock tractor in place. Excessive tension will cause pin hole deformation and degrade paper stacking.
9. Applying a slight downward tension, load paper on lower tractors as in steps 6 to 8 for upper tractors (see Figure 6-3).
10. Set Paper Gap Adjuster for paper thickness in use (see step 6 and CAUTION).
11. Set Paper Tension Adjust lever for approximate paper thickness in use.

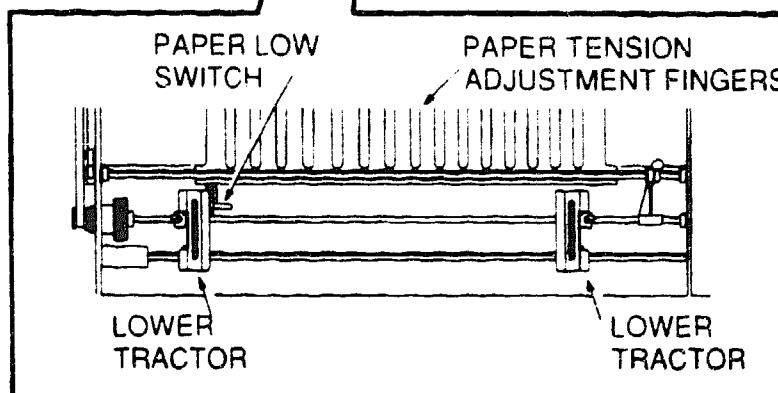
Figure 6-3: Paper Loading, Lower Tractor

TRACTORS
(PAPER DRIVE
MECHANISM)



COOLING
FAN

PAPER
SUPPLY



PAPER LOW
SWITCH

PAPER TENSION
ADJUSTMENT FINGERS

LOWER
TRACTOR

LOWER
TRACTOR

RE UK00967A 89

6.3 Installing/Replacing Ribbon Cartridge

To install the ribbon cartridge, carry out the following steps:

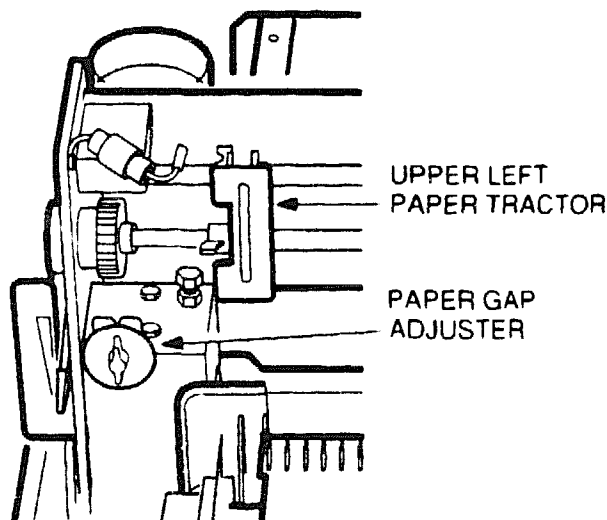
1. Open printer top access door with the cover interlock switch (located on the top left of the printer).
2. Raise cover interlock switch to its highest position.
3. Clear the [c o] (cover open) error indicator, by pressing the text CLR push button.

NOTE

In replacing the ribbon cartridge (paper thickness remains unchanged), note the paper gap adjuster setting for use in step 7.

4. Turn print gap adjuster clockwise to LOAD position for maximum opening (see Figure 6-4).

Figure 6-4: Ribbon Cartridge Installation, Paper Gap Adjuster Setting



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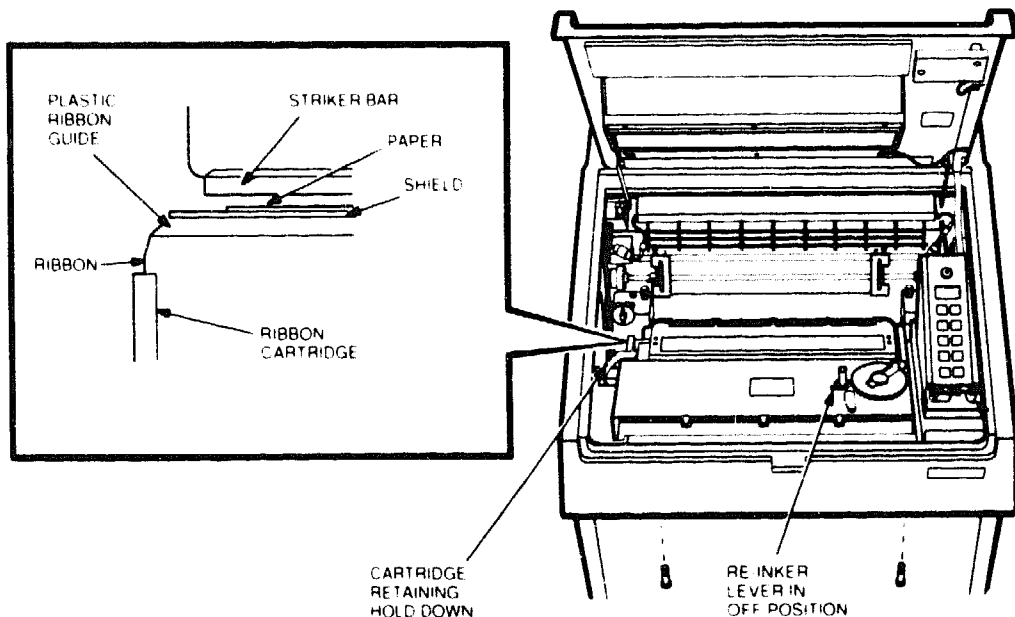
5. If replacing the ribbon cartridge unsnap ribbon cartridge holddown at left side of ribbon cartridge (see Figure 6-5).

NOTE

The LG31 printer has a ribbon weld sensor that detects the point where the two ends of the ribbon are welded together. Printing is temporarily suspended for a few seconds until the ribbon weld passes a certain point for printing to resume. If display [S U S] persists for more than one minute, it may be caused by a damaged ribbon or defective ribbon weld detector.

6. Remove the old ribbon cartridge.
7. Turn knurled knob on new ribbon cartridge clockwise to remove any slack in ribbon (see Figure 6-5). Be sure re-inker is ON (rotated fully clockwise).

Figure 6-5: Ribbon Cartridge Installation, Holddown and Re-Inker



8. Tilt ribbon cartridge downward to the left and install left side first (left edge of cartridge will guide ribbon between the ribbon guide and shield as shown in Figures 6-5 and 6-6). Then lower right side onto ribbon motor drive shaft. Turn knurled knob a few times to verify that ribbon is running freely and to remove any remaining slack.
9. Snap ribbon cartridge holddown in place over left side of ribbon cartridge.
10. Reset print gap adjuster to original setting or to a setting appropriate to new paper thickness.
11. Close door in printer top enclosure and press the ON LINE push button.
12. Clear the "Striker Bar Open" [S b o] fault indicator by pressing the TEST CLR push button once.
13. Perform a printing self test. Refer to Section 5.2.2.

NOTE

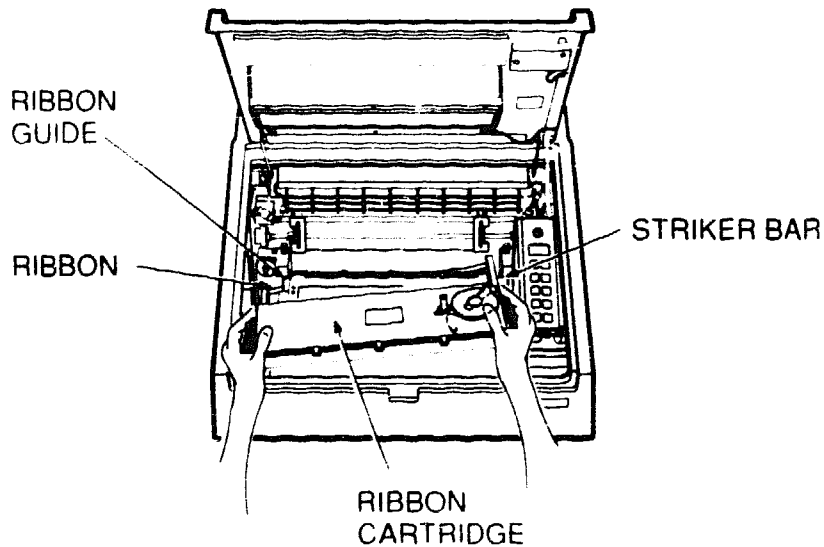
When the printer quality starts fading, turn the re-inker on (see Section 6.4).

6.4 Re-Inking Ribbon

Turn the ribbon re-inker on when the Ribbon Cartridge is installed. Once turned on, leave it on for the life of the cartridge. To re-ink the ribbon:

1. Open the top cover.
2. Move the re-inking lever on the ribbon cartridge about one half-turn clockwise.
3. Close the cover.

Figure 6-6: Ribbon Cartridge Installation, Ribbon Guide and Striker Bar



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6.5 Paper Motion

For many paper motion operations, there are four ways to perform the operation:

1. In off-line mode, when printer control strap A26 is OUT, directly from the associated keys on the control panel.
2. In off-line mode, when printer control strap A26 is IN, directly from the associated keys on the control panel.
3. In program mode, from the configuration menu (see Chapter 4).
4. In function mode (see Chapter 4).

The off-line method is given in the following sections.

6.5.1 Form Feed

To perform a form feed operation, place the printer off-line ([O F L] is displayed). Press the FORM FEED key.

See Chapter 4, Section 4.4.3 and 4.4.6 for alternate methods.

6.5.2 Line Feed

To perform a line feed operation, place the printer off-line ([O F L] is displayed). Press the LINE FEED key.

See Chapter 4, Section 4.4.3 and 4.5.2 for alternate methods.

6.5.3 Forward Microstepping

See Chapter 4, Section 4.4.3 and 4.5.2.

6.5.4 Reverse Microstepping

To perform a reverse microstep operation (1/72 inch increment), place the printer off-line ([O F L] is displayed). Press the PAPER REV key.

See Chapter 4, Section 4.4.3 and 4.5.2 for alternate methods.

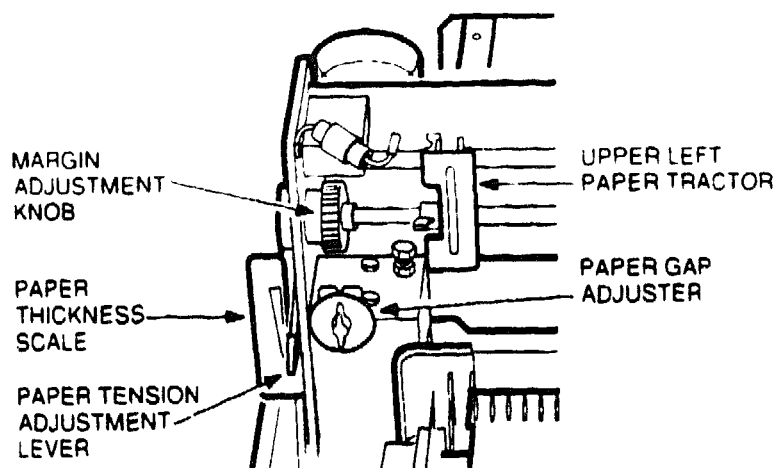
6.5.5 Reverse Form Feeds

See Chapter 4, Section 4.4.3 and 4.5.6.

6.6 Aligning Paper

There is a fine horizontal adjust on the LG31 printer. this lets you move the form paper with respect to the printing heads. The adjustment is shown in Figure 6-7.

Figure 6-7: Margin Adjust Knob



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6.7 Buffer Clear

To clear the buffer, carry out the procedure in Chapter 4, Section 4.5.7.

6.8 Low Paper Printing

The low paper switch is activated when 21.3 cm (8.4 in) of paper remains in the printer. At this point, a choice may be made to discontinue printing or enter the Low Paper Print (LPP) mode and continue printing for a maximum of 21.3 cm (8.4 in). During the LPP mode, the key (6) PAPER REV is inoperative, but works normally during paper out [P O] and striker bar open [S b o], so that Top Of Form can be set. The low paper printing procedure is shown in Table 6-1.

Note

Setting the paper tension adjust lever to 6 (minimum gap) to increase paper tension will improve printout during low paper printing.

Table 6-1: Low Paper Printing Procedure

Action	Result
When the low paper switch is activated:	Displayed alternately between [L o P] and [On L]. Printer remains on-line.

NOTE

To DISCONTINUE printing, proceed to step indicated by *.

To CONTINUE printing, carry out the following steps.

Press (0) TEST CLR	Displayed alternately between [L P P] and [On L].
• Lines terminated with <LF> will continue to move paper normally until bottom of form is reached and LPP mode is terminated.	Buffered lines are printed and data transmission continues to the end of form. When paper is replenished, printing continues on the first form of the new supply with correct vertical positioning maintained.
• Lines terminated with <CR> (bold print, underline) will move paper normally until bottom of form is reached and LPP mode is terminated.	
• Receipt of <FF> terminates LPP mode.	
• Receipt of <VT>, VPR, forward VPA (see NOTE 1) or EVFU command moves paper normally until a command is received, which would move paper beyond end of form. The LPP mode is terminated.	
• Receipt of subscript or superscript command (ANSI Emulation) will move paper normally until bottom of form is reached and LPP mode is terminated.	

Table 6-1 (Cont.): Low Paper Printing Procedure

Action	Result
When paper movement causes LPP mode to be terminated.	Displayed alternately between [P o] and [O F L]. Printing ceases. Audio alarm sounds once (see NOTE 2).
Replenish paper supply. Place perforation below upper tractor notches and LINE FEED into position to avoid having to back up into the perforation skip-over area.	No change.
Press (8) SET TOF, then (0) TEST CLR.	Buffered lines are printed. Paper moves to first print position of next form and printing resumes. Displayed is [O F L]. Paper out condition is cleared.

NOTE

To discontinue printing at LOW PAPER indication, carry out the following steps:

*Press (3) ON LINE Press (0) TEST CLR	Display changes to [O F L]. Displayed alternately between [L P P] and [O F L]. Buffered lines are printed.
Press (0) TEST CLR again.	Displayed alternately between [P o] and [O F L]. A paper out condition exists.
As required, replenish paper supply. Place perforation below upper tractor notches and LINE FEED into position to avoid having to backup into the perforation skip-over area.	No change.

Table 6-1 (Cont.): Low Paper Printing Procedure

Action	Result
Press (8) SET TOF, then (0) TEST CLR.	Buffered lines are printed. Paper moves to first print position of next form in readiness for use. Paper out condition is cleared. Displayed is [O F L].

NOTES

1. A reverse VPA command is converted to a forward line feed. Continuity of location cannot be maintained for reverse VPA commands.
2. The serial interface control switches for READY/BUSY may be enabled to cause the following actions at LPP termination:

A4 IN, switch SCA to the active state
A5 IN, send XOFF or DC3
A6 IN, send BREAK

6.9 Hex Dump

HEX DUMP printed data is useful primarily to application programmers or customer service representatives as a program debugging or troubleshooting tool.

To enable HEX DUMP, set the printer control strap A32 IN. Place the printer on-line.

HEX DUMP causes data received from the host to be printed out in hexadecimal ASCII form instead of normal printing. A sample is shown below. The hexadecimal printout is shown on the left side and the equivalent plain language printout is shown on the same line at the right side. Exceptions: ASCII control characters below hexadecimal 20 are printed out as periods. <SP> or hexadecimal 20 causes a blank space in the equivalent print position. Thus the programmer can examine all program codes and instructions to determine whether any are correct.

For example, in the first line below, we have:

<DC1><DC3><ESC>K<ESC>L<CR><LF><ESC><SP> YZ<CR><LF>.

This is a HEX DUMP example printed at a pitch of 10 CPI in DP font.

While debugging, we may find an error such as <DC2> instead of <DC1> (12 instead of 11) or a lower case k instead of an upper case K (6B instead of 4B), and so forth.

In this way, the entire program can be examined for possible errors.

```
11 13 1B 4B 1B 4C 0C 0D 1B 5C 20 59 5A 0D 0D 54 ...K.L...\ YZ..T
48 49 58 20 41 20 48 45 58 20 44 55 4D 50 20 45 HIS A HEX DUMP E
58 41 4D 50 4C 45 20 50 52 49 4E 54 45 44 20 41 XAMPLE PRINTED A
54 20 41 20 50 49 54 43 48 20 4F 46 20 31 30 20 T A PITCH OF 10
49 50 49 2E 20 49 4E 20 44 2E 50 2E 20 46 4F 4E CPI. IN D.P. FON
54 0D 00 00 00 00 00 00 00 00 00 00 00 00 00 00 T.....
```

When data transmission is ended and HEX DUMP is no longer needed, be sure to place the printer in OFF LINE. If any HEX DUMP data remains in the buffer, this will cause it to be printed out and clear the buffer. Also, return the printer control strap 32 to its OUT condition.

Chapter 7

OPERATOR MAINTENANCE

7.1 Introduction

The LG31 printer does not require scheduled preventive maintenance. Operator maintenance consists of the following:

- Normal cleaning
- Changing ribbon cartridges
- Changing paper

The operator should carry out the following maintenance services whenever replacing the ribbon cartridge or as required:

1. Turn power OFF and disconnect the ac power cable from the power outlet.
2. Remove the ribbon cartridge and wipe away any accumulation of dust from the ribbon guide striker bar area.
3. Remove paper lint/chaff accumulations inside the printer with a soft brush or vacuum. The striker bar area and the paper supply compartment are especially prone to paper dust and dirt build-up.
4. Reinstall or replace the ribbon cartridge, if print legibility is not acceptable.
5. Clean the outside surfaces with a clean damp cloth (do not use cleaning solutions). Wipe with a dry cloth to dry the cabinet surfaces.

7.2 Operator Troubleshooting

Faults related to incorrect paper control or configuration settings are operator correctable. Check the current configuration and switch settings for erroneous settings (see Chapter 4 for proper settings). Possible mechanical, electrical, and EVFU problems and the remedial actions taken before calling for service, are listed in Tables 7-1 and 7-2.

NOTE

Before calling for service, always perform the initialization sequence described in Chapter 4. If one of the fault indications listed in Table 7-1 appear on the display, report this when calling for service.

WARNING

Dangerous voltages exist in the LG31. There are no internal user serviceable parts. Refer to qualified service personnel.

Table 7-1: Possible Mechanical Problems and Remedies

Observed Problem	Probable Cause and Remedies
Printer will not print. Display is [P o].	Out of paper. Install paper (if forms, align paper with notches in top tractors). When paper is inserted in bottom tractors, paper out switch is pressed and the fault cleared. Printer is off-line. Press ON LINE key to print.
Printer will not print. Display is [r c o].	Ribbon cartridge is out. Replace in accordance with the "Ribbon Cartridge" procedure in Chapter 6.
Printer will not print. Display is [S b o].	Striker bar open. Adjust striker bar and check other settings as noted under "Load Paper" procedure in Chapter 6.
Printer stalls and printer is locked up. Display is [S d r].	Motor driver interference due to: •Paper jam •Paper gap too small Turn power OFF, correct problem, and turn power ON.

Table 7-1 (Cont.): Possible Mechanical Problems and Remedies

Observed Problem	Probable Cause and Remedies
Light printing.	Ribbon worn; install new ribbon cartridge. Set paper gap adjuster and/or paper tension adjust lever for smaller gap.
Ribbon droops on one side during printing or outer columns of print missing.	Ribbon cartridge improperly installed. Check installation by repeating ribbon cartridge installation procedure in Chapter 6. Print module too close to paper; reset paper tension adjust lever to 1 (maximum gap setting) for thicker paper to prevent drag (6 setting = minimum gap setting).
Paper does not feed properly.	Paper supply in lower compartment not aligned properly. Realign. Paper not loaded properly. Refer to "Load Paper" procedure in Chapter 6.
Elongation of paper pin feed holes, tractor disengagement from holes, paper tearing.	Excessive paper tension. Reduce tension by readjusting paper tension adjust lever to lower setting (1=maximum/6=minimum).
Weak or absent printing in some columns, degraded print quality in one decimeter (4.3 inch) wide zone of the print area. Display is [A c 1], [A c 2], or [A c 3].	Defective print actuator module. Call a service engineer to replace module. Ensure that ribbon cable connections to modules are tight. If problem remains and is localized in the same print zone, the cable or SHAD board may be defective. Call for service. The printer may be used, if light or missing dots can be tolerated.
[L o P]*	Low Paper
[L P P]	Low Paper Printing. Permits printing after Low Paper is detected (see "Low Paper Printing" procedure in Chapter 6).

*TEST CLR key must be pressed momentarily after fault is cleared to reset from fault condition. Audio tone sounds with these flashing fault displays.

Table 7-2: Possible Electrical Problems and Remedies

Observed Problem	Probable Cause and Remedies
No indication on front panel when power switch turned ON.	The power cord is not plugged into wall outlet or into rear of printer. The wall outlet may be defective. If it does not operate, call an electrician to fix outlet.
Some keys are inoperative.	Printer is in lock-up mode. Check configuration switch settings; reinitialize printer configuration (refer to Chapter 4, Section 4.5.1).
Printer does not respond correctly to front panel keys.	Invalid configuration causing printer to lock up. Turn power switch OFF and then back ON. If problem persists, perform "Printer Initialization Procedure" in Chapter 4. Selected speed (baud rate) not compatible with data source. Reset speed (see Chapter 4). Parity selected is not compatible with data source. Reset printer parity type (see Chapter 4).
[S L o]	Slow printing. This display flashes while the print rate is reduced by the thermal throttle. Normally occurs only during high density printing. No damage occurs, printing continues at reduced speed. Automatically clears when temperature falls below throttle threshold and normal printing speed resumes.
[S U S]	Suspended print. 1. After power-up, the first print segment will be delayed while the ribbon moves a specific distance. 2. After power-down, this display will appear briefly before going blank because low energy is detected. 3. Low energy from the power supply will produce this display. 4. As the end of the ribbon passes the print wires, printing is suspended resulting in this display.

Table 7-2 (Cont.): Possible Electrical Problems and Remedies

Observed Problem	Probable Cause and Remedies
	5. This display will be produced by the ribbon weld detector sensing a damaged ribbon or defective ribbon weld detector.
[0 2 0] [4 2 0]	Occasionally, usually after transporting, the printer can lock up with one or both of these codes. Press the reset twice to clear and then perform the power up reset sequence detailed in Table 4.4, followed by the initialization procedure in Table 4.3. If the fault recurs after power off, the error codes are valid as in Table 5.2.

7.3 Printer Parameters

The factory settings for the printer are listed in Table 7-3.

NOTE

The following tables refer to "Control Functions", which are listed in the *LG31 Printer (V1.31.000-CSS and Later CSS Variants) User's Guide EK-LG31C-UG*.

Table 7-3: Factory Settings

Selectable Parameter	Factory Set Condition
Print Status	Off-Line
Horizontal Pitch	10 characters per 2.54 cm/in
Vertical Pitch	6 lines per inch
Font	Data Processing
Forms Length	66 lines (11 in/27.94 cm)
Active Position	Column 1, Line 1
Top Margin	Line 1
Bottom Margin	Line 66
Left Margin	Column 1
Right Margin	Column 132
Underlining	Disabled
Bolding	Disabled
Italics	Disabled
Character Expansion	Disabled
GL Character Set	U.S. ASCII
GR Character Set	Digital Supplemental
G0 Character Set	U.S. ASCII
G1 Character Set	VT100 Graphic Character Set
G2 Character Set	Digital Supplemental
G3 Character Set	U.S. ASCII
Autowrap	Enabled
Line Feed/New Line Mode	Set
Horizontal tabs	At every 8 columns (9, 17,...137)
Unsolicited reports	Disabled
Super/Subscripts	Disabled
Carriage Return New Line Mode	Reset
Vertical Tabs	Every line (1, 2, ... 66)
Number of data bits	8-bit mode
Number of stop bits	1 stop bit
Speed (baud rate)	9600 baud
Parity	Disabled

7.3.1 Power-Up Parameters Set

Table 7-4 lists the default conditions upon power-up of the LG31 printer.

Table 7-4: Printer Parameters Power-Up Set

Selectable Parameter	Power-Up Condition
Print Status	Off Line
Active Position	Column 1 on current active line
Underlining	Disabled
Bolding	Disabled
Expansion	Disabled
Unsolicited Reports	Disabled
Super/Subscripts	Disabled

7.3.2 Power-Up Parameters Retained

Upon power-up of the LG31 printer, the parameters that will be retained from the previous power-on session are listed in Table 7-5.

Table 7-5: Printer Parameters Retained on Power-Up

Selectable Parameter
Horizontal Pitch
Vertical Pitch
Font
Top of Form
Forms Length
Top and Bottom Margin
Left and Right Margin
Autowrap
Line Feed/New Line
Carriage Return/New Line Mode
Horizontal Tabs
Vertical Tabs
GL Character Set
GR Character Set
G0 Character Set
G1 Character Set
G2 Character Set
G3 Character Set
All Interface Settings

7.3.3 Reset State

When the LG31 printer receives a reset sequence from the host computer or the inner control panel (operator's input), the printer is set to the default settings (see Table 7-6).

A RESET sequence does not change the following:

- Any interface settings
- National Replacement Character (NRC) set
- Top of Form

The above parameters remain as previously selected, either through escape sequences or through the inner control panel.

Table 7-6: Reset State Default Parameters

Selectable Parameter	Reset Default Condition
Print Status	On-line (ready)
Horizontal Pitch	10 characters per 2.54 cm/in
Vertical Pitch	6 lines per inch
Font	Data Processing
Forms Length	66 lines (11 inches/27.94 cm)
Active Position	Column 1 on the current active line (line 1)
Top Margin	Line 1
Bottom Margin	Line 66
Left Margin	Column 1
Right Margin	Column 132
Underlining	Disabled
Bolding	Disabled
Italics	Disabled
Character Expansion	Disabled
GL Character Set	U.S. ASCII or the last NCR if selected
GR Character Set	Digital Supplemental
G0 Character Set	U.S. ASCII or the last NCR if selected
G1 Character Set	VT100 Graphic Character Set
G2 Character Set	Digital Supplemental
G3 Character Set	U.S. ASCII
Autowrap	Enabled
Line Feed/New Line Mode	Set
Horizontal tabs	At every 8 columns (9, 17,...137)
Unsolicited reports	Disabled
Super/Subscripts	Disabled
Carriage Return	Reset
New Line Mode	
Vertical Tabs	Every line (1, 2, ... 66)

The following will not change:

All Interface settings

The National Replacement Character Set

These parameters will remain as previously selected, either by escape sequence or control panel.

Appendix A

LED DISPLAY LIST

A.1 List of All Control Panel Readouts

The following is a list of every message indication that may appear on the LG31 printer LED display to alert the operator to the printer's operational status.

LED DISPLAY LIST

Display	Meaning
[A c X]	Head test or SHAD board (X indicates module number of bad actuator, 1=left, 2=middle, 3=right).
[.A d j]	Printer enters adjustment mode.
[.A P L]	Amplitude pattern.
[.c b P]	Checkerboard pattern.
[c h r]	Character.
[C L r]	Printer enters buffer clear mode.
[c o]	Cover open
[C P I]	Characters per inch.
[C S U]	Reset state.

[.F A d]	Forms adjustment. The printer is in Forms Adjustment mode.
[.F n c]	Function. The printer has entered the function mode.
[F o n]	Font.
[.F S U]	Forms setup mode.
[F 0 0]	Data processing 10 CPI.
[F 0 1]	Data processing 12 CPI.
[F 0 2]	Data processing 13.3 CPI.
[F 1 0]	Gothic NLQ 10 CPI.
[F 1 2]	Gothic NLQ 12 CPI.
[F 1 3]	Gothic NLQ 13.3 CPI.
[F]	Gothic NLQ 15 CPI.
[F 3 0]	Italic NLQ 10 CPI.
[F 3 1]	Italic NLQ 12 CPI.
[F 3 2]	Italic NLQ 13.3 CPI.
[F 8 0]	Bar code.
[F 9 0]	Oversize characters.
[.H t P]	Horizontal timing pattern.
[I n F]	No operational interface found.
[.IS.U]	Initialize printer to factory default conditions.
[L o P]	Low paper.
[L P P]	Low paper printing. Permits printing after Low Paper is detected.
[.L r S]	Margin setup mode.
[L P I]	Lines per inch.
[O F L]	Off-line. The printer is off-line.
[On.L]	On Line. The printer is on line with a data source.
[P o]	Paper out. The paper supply has run out.

[P r o]	Program. The printer is in Program mode.
[r c o]	Ribbon cartridge out.
[S b o]	Striker bar open.
[S d r]	Shuttle motor driver. Shuttle motor driver interference to paper stuck or paper gap too small.
[S L o]	Slow printing. This display flashes while the print rate is reduced by the thermal throttle.
[. S U]	Printer enters initialization mode.
[S U S]	Suspended print.
[.S i 9]	Prints short segments of various test patterns or executes a form feed.
[.U t P]	Vertical timing pattern.
[0 2 0]	SMSM Lithium Battery (BT1) (see Table 7.2).
[0 2 2]	SMSM has insufficient RAM.
[0 4 X]	SMSM RAM, display indicates chip number at fault. For U41, X=1; for U42, X=2, and so forth.
[0 5 0]	SMSM memory failed to switch (U9-U13, U18-U25, U32-U35, U42).
[0 5 5]	SMSM switchable RAM failure (PD4016C-2 in U11 and U21).
[0 6 0]	SMSM 7.5 interrupt failure (Timer at U30 to CPU at U3 circuit.
[0 8 0]	SMSM IMA (includes U37, U38, U42, U43, U50-U54).
[1 0 0]	Missing TOF code in EVFU load sequence.
[1 0 2]	Invalid characters in EVFU load sequence.
[1 0 3]	EVFU table length exceeded.
[1 0 4]	ANSI EVFU load multiple TOFs sensed.
[4 2 0]	SMIM Lithium Battery (BT1) (see Table 7.2).
[4 4 0]	SMIM RAM (U19-U22) SMIM RAM circuit chip (2K or 8K) may be located in sockets U19-U22 only.
[4 9 0]	SMMC shuttle motor drive.

- [4 9 1] SMMC shuttle frequency out of range.
- [4 9 2] SMIH imaging hardware failure.
- [4 9 3] SMMC or SMIH board (no shuttle interrupt). Check all SMIH jumper positions.
- [4 9 4] No INT signal available to cause paper motion.
- [5 2 9] SMSM NVRAM (5517L in U29).
- [5 3 0] SMSM timer chip (8253 in U30).
- [5 3 1] SMSM interrupt controller (8259A in U31).
- [5 4 7] SMSM ROM (U47).
- [5 4 8] SMSM ROM (U48-U49).
- [5 4 9] SMSM ROM (U48-U49).
- [7 0 0] SMIM, SMSM failure (image processor).
- [.8.8.8] Used to test all the LED lights when power is turned ON. Lasts only a few seconds.
- [i P] Indicates self-test in progress. Lasts for several seconds after power on sequence.
- [i 9 P] Intermodule gap return.
- [i 1 3] SMIM image processor timer chip (8253 in U13).
- [i 1 4] SMIM interrupt controller (8259A in U14).
- [i 2 0] SMIM ROM (U20-U22) image processor (display indicates chip
through number at fault).
- [i 2 2]
- [i 2 2] SMIM RAM (U22)
- [i 2 5] SMIM NVRAM (5517L in U25-U32) (display indicates chip
through number at fault).
- [i 3 2]
- [i 3 3] 2K SMIM RAM (U33)
- [0 5] Data Processing font is selected using the key (5) CPI LPI.
through Display shows selected characters per inch (CPI).
- [1 5]

[1 6 E]	Data Processing (Enhanced) font (16.7 CPI) selected.
[0 2 L]	Number of lines per inch (LPI) while selecting from the menu.
through	
[1 2 L]	
[n 0 5]	CPI in gothic NLQ while selecting from the menu.
through	
[n 15]	
[.0 0 0]	Counter used during certain function modes.
through	
[2 2 0]	
[0 1 o]	The first two digits indicate the currently selected software
through	strap. The third digit indicates either "o" for strap out, or "i" for
[3 3 o]	strap in.
[O C A]	When OCR-A is selected.
[O C b]	When OCR-B is selected.

Appendix B

PARAMETER SELECTION

Figure B-1 contains the configuration menu with the parameter options available on the LG31 printer.

Figure B-2 contains the function mode options available on the LG31 printer.

Figure B-1: Configuration Menu with Program Mode Parameters

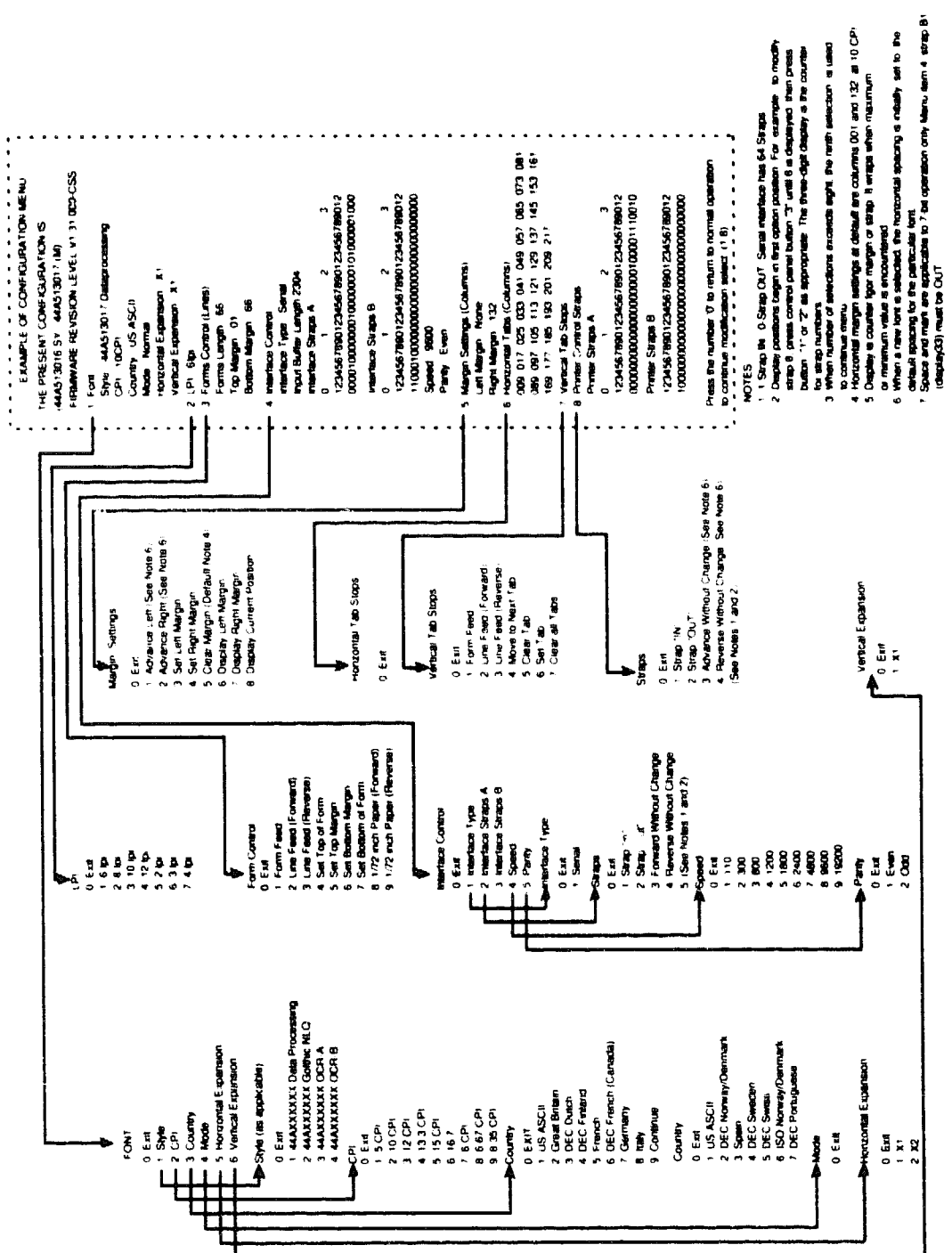
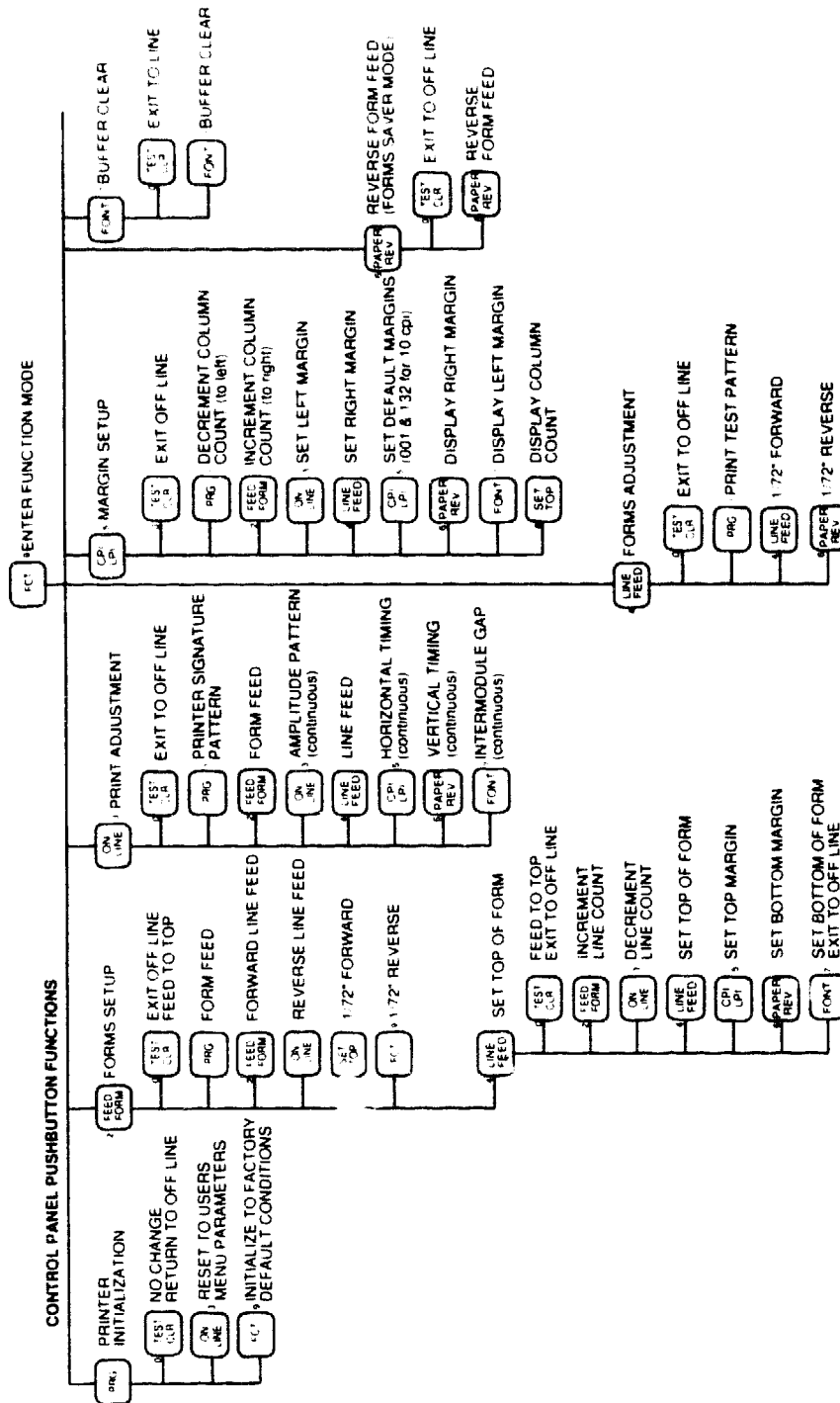


Figure B-2: Function Mode Options



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[illegible][illegible]

Appendix C

LG31 COUNTRY KITS

2R-LG31-A4 U.S., Power Cord, 17-00083-09

All country kits include the following:

Kernel Documentation Kit EK-LG31C-DK

EK-LG31C-UG	<i>LG31 Printer (V1.31.000-CSS and later variants) User</i>
EK-LG31C-IN	<i>Guide (English)</i>
	<i>LG31 Printer (V1.31.000-CSS and later variants) Instal-</i>
	<i>lation / Operator's Manual (English)</i>

Binder

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LG31 Printer (V1.31.000–CSS and Later Variants)

User's Guide

Order Number: EK–LG31C–UG–002

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Preface

This manual is written for personnel experienced in one or more programming languages, serial interface installation and printer configuration. This manual describes the LG31 control codes and control sequences, and describes how to configure the printer functions using the interface control straps and the printer control strap.

MANUAL ORGANIZATION

- **Chapter 1, LG31 Features** – Describes the printer, provides the theory of operation, and lists the printer's electrical, mechanical, and functional specifications.
- **Chapter 2, Printer Control Strap Configuration** – Shows how to print out the printer's configuration status, and how to access and reconfigure the printer control straps. Describes the printer control straps and their factory settings.
- **Chapter 3, Interface Configuration** – Describes the serial interface hardware, pin numbers and signals, XON/XOFF protocol, and input buffer processing. Shows how to print out the printer's configuration status, and how to access and reconfigure the interface control straps. Describes the interface control straps and their factory settings.
- **Chapter 4, Character Processing** – Describes how the LG31 printer processes control characters and printable characters in text mode.

- **Chapter 5, Text Mode Escape and Control Sequences** – Describes the escape and control sequences, and control strings used by the LG31 printer in text printing.
- **Chapter 6, Printer ID, Status, and Reset Sequences** – Contains information on how to implement device attributes, device status, and reset control sequences.
- **Chapter 7, Sixel Graphics** – Describes how to implement sixel graphics using LG31 control sequences.
- **Chapter 8, Vector, Bar Code, and Block Character Sequences** – Describes how to implement vector drawing, bar code printing, and block character sequences using LG31 control sequences.
- **Appendix A, Character Sets** – Shows the 16 character sets supported by the LG31.
- **Appendix B, Control Code and Control Sequence Summary** – Provides a summary of the control codes and control sequences used by the printer.
- **Appendix C, Factory, Power-up, and Reset Defaults** – Contains the configuration information of the LG31 printer as shipped from the factory, the list of parameters which are reset and saved on power-up, and a list of the parameters that are reset when a reset control sequence is sent to the LG31 printer.
- **Appendix D, VFU Cross Reference Table** – Provides a cross reference between the VFU Table byte pair bit patterns and the equivalent characters, decimal, and hexadecimal values.
- **Glossary**
- **Index**

Related Documentation

The Customized LG31 Documentation Kit EK-LG31C-DK consists of the following:

LG31 Printer (V1.31.000-CSS and Later CSS Variants) User's Guide,
EK-LG31C-UG

*LG31 Printer (V1.31.000-CSS and Later CSS Variants) Installation and
Operator's Manual*, EK-LG31C-IN

LG31 Printer Pocket Service Guide, EK-LG31E-PS

LG31 Printer Technical Manual, EK-LG31E-TM

LG31 Printer Illustrated Parts Breakdown, EK-LG31A-IP

Conventions

In writing this manual, the following conventions have been adopted for the mechanical objects listed below

- Control Panel Keys = Capitalized key legend

Example: OFF LINE

- LED Three-Character Display = Bracketed three characters including flashing printer mode dots

Example: [.8.8.8]

- Number Designated Keys = Parenthesis enclosed number designation

Example: (4)

Notes, Cautions, and Warnings

Throughout this manual Notes, Cautions, and Warnings have the following meanings:

NOTE: The information is important to the understanding of the process being described.

CAUTION: The information describes a process that can damage the equipment or software.

WARNING: The information describes a process that can harm the user.

Assistance

If you have a problem with the LG31 printer, carry out the following steps:

1. Confirm that the problem can be repeated by recreating the identical conditions leading up to the problem. A vital step may have been overlooked which is causing the problem.
2. Identify the problem using the "Troubleshooting" section in Chapter 7 and the list of LED display messages in Appendix A to determine if the problem can be resolved in-house. If not, the local Digital Equipment Corporation Customer Service organization should be contacted.
3. If required, report the problem to Digital Equipment Corporation Customer Service. Consult your service contract for the information required to process your call.

WARNING

Dangerous voltages exist in the LG31 printer. There are no internal user serviceable parts. Refer servicing to qualified service personnel.

FCC Statement (A)

Notice

This equipment generates, uses, and may emit radio frequency energy. The equipment has been type tested and found to comply with the limits for a Class A computing device pursuant to Subpart J of Part 15 of FCC rules, which are designed to provide reasonable protection against such radio frequency interference. Operation of this equipment in a residential area may cause interference in which case the user at his own expense will be required to take whatever measures may be required to correct the interference.

Chapter 1

LG31 FEATURES

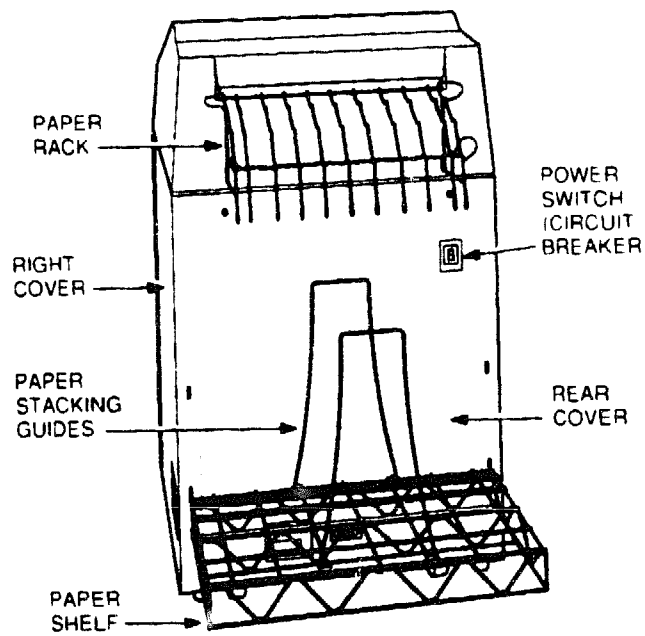
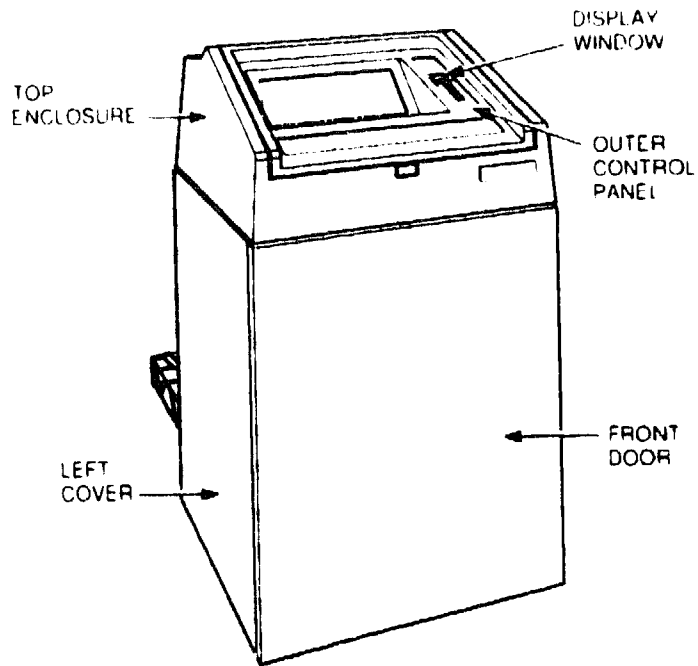
1.1 Overview

This chapter contains a general description of the LG31 300 LPM Line Matrix Printer. It includes a brief description of the printer, provides the theory of operation, and a lists the printer's electrical, mechanical, and operational specifications.

1.2 General Description

The LG31 Line Matrix Printer (see Figure 1-1) is a high-speed printer capable of printing up to 300 lines-per-minute through a serial interface. It has a universal power supply capable of operating at any voltage between 100 and 240 V, at 50 to 60 Hz, without any modifications.

Figure 1-1: LG31 Line Matrix Printer



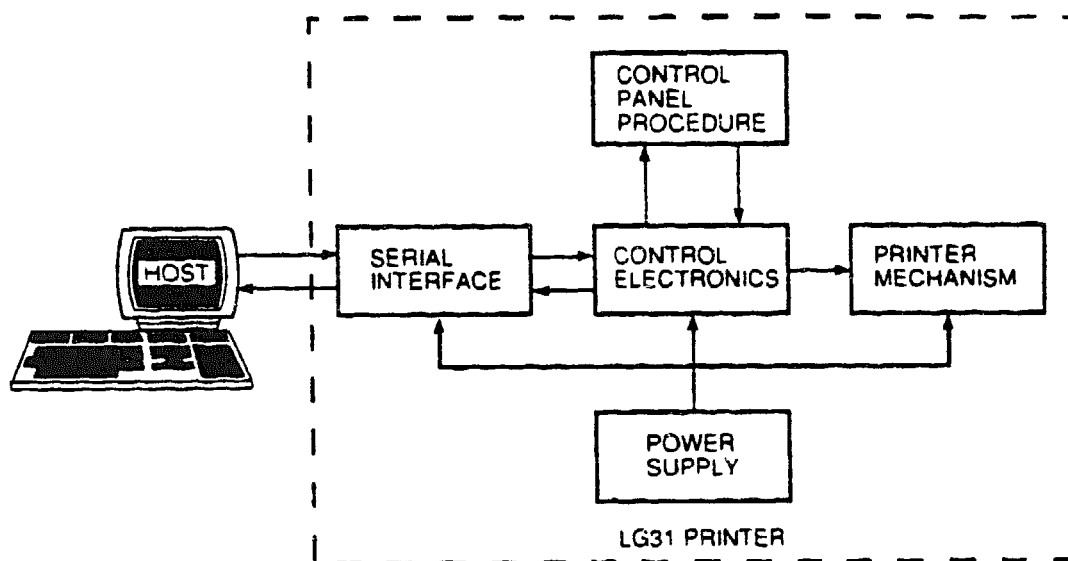
RE JK00270A 8

1.3 Theory of Operation

The LG31 is composed of five basic operational blocks (see Figure 1-2):

- The serial interface.
- Control panel.
- Control electronics.
- Power supply.
- Printer mechanism.

Figure 1-2: LG31 Functional Block Diagram



RE J4100250M 85

1.3.1 Serial Interface

The serial interface provides the bidirectional communications link between the host and the printer. Bidirectional communications allows data to be sent to the printer, and various types of data (XON/XOFF, status reports, printer ID) to be sent to the host from the printer.

1.3.2 Control Panel

The control panel provides the bidirectional communications link between the operator and the printer. Bidirectional communications allows the operator to send reconfiguration commands and basic print commands to the printer, and allows the printer to pass configuration, error, and printer status information to the operator either through printouts or through the control panel indicators.

1.3.3 Printer Mechanism

The printer mechanism consists of the mechanical and electromechanical hardware in the printer. The printer mechanism performs ribbon and paper motion and converts the binary print data to printed characters on paper using the printer actuators.

1.3.4 Control Electronics

The control electronics coordinate the functions and operations of the serial interface, control panel, and printer mechanism.

1.3.5 Power Supply

The power supply provides regulated dc power to the printer's electronic and electromechanical devices. The raw ac power is rectified and regulated to assure reliable printer operation. The power supply automatically adjusts to ac input voltages in the range of 100 to 240 V at 50 to 60 Hz, and constantly monitors the dc voltages to provide correct voltage regulation.

1.4 Specifications

1.4.1 LG31 Printer Specifications

Table 1-1: LG31 Printer Specifications

Printer Dimensions

Unpacked

Width	73.75 cm (29.0 in)
Depth	63.5 cm (25.0 in)
(with Paper Tray)	104.1 cm (41.0 in)
Height	123 cm (48.4 in)
Net Weight	131 kg (287 lbs)

Packaged

Width	77.5 cm (30.5 in)
Depth	88.9 cm (35 in)
Height	156.2 cm (61.5 in)
Weight	171 kg (376 lbs) (includes 16 kg (35.2 lbs) of accessories consisting of paper shelf, upper paper rack, and ribbon cartridge)

Installation Area Requirements

Width	137 cm (54 in) (To allow air flow clearance for printer side vents)
Depth	206.5 cm (104 in) (To allow free access to front and rear paper handling areas, the ON/OFF switch, and the power cables)

Electrical

Voltage Range	100 to 240 V ac
---------------	-----------------

NOTE

The printer's universal power supply automatically accepts international voltage and frequency variations.

Input Frequency Range	50 Hz to 60 Hz
Harmonic Distortion	5% maximum allowable
Power Rating	
Standby	50 W
Printing	400 W
Shuttle Frequency	20 Hz
Dissipated Power	
Standby	171 BTU/hr
Printing	1368 BTU/hr

Table 1-1 (Cont.): LG31 Printer Specifications

Radio Frequency Interference	Tested/certified to RFI standards FCC 15, Subpart J, Class A; VDE 0871 Class B
Acoustic Noise	LNPA 6.7 bels LPA 55 dBA
Operating	
Altitude	2.4 km (0 to 8,000 ft)
Temperature	10°C to 40°C (50°F to 104°F) Maximum allowable reduced by factor 1.8°C/1000 m (1°F/1000 ft)
Relative humidity	10% to 90% non-condensing with a maximum wet bulb temperature of 28°C (82.4°F) a minimum dew point 2°C (35.6°F)
Non-operating	
Altitude	4.9 km (0 to 17,700 ft)
Temperature	-40°C to 66°C (-40°F to 150.8°F) Maximum allowable reduced by factor 1.8°C/1000 m (1°F/1000 ft)
Relative Humidity	5% to 95% non-condensing
Printing	
Line Length	33.5 cm (13.2 in)
Lines Per Inch (LPI) Spacing	2, 3, 4, 6, 8, 10, 12 (plus double and triple vertical expansion)
Characters Per Inch (CPI)	5, 6.67, 8.35, 10, 12, 13.3, 15, 16.7 (plus double horizontal expansion)
Paper Slew	50.0 cm/sec (20 in/sec)
Line Feed	12.5 msec at 6 lines/inch
Horizontal Tabs	198 positions
Vertical Tabs	66 positions
Paper/Forms	
Paper width	76.2 mm (3 in) to 420.1 mm (16.54 in)
Form Length	8.4 mm (0.33 in) to 559 mm (22 in)
Fan Folds	152 mm (6 in) to 305 mm (12 in)
Paper weight	90 g/m ² (24 lbs) for single ply paper
Form Thickness	Less than 0.63 mm (0.025 in)
Card Stock	Up to 163 g/m ² (100 lbs) can be used

1.4.2 Recommended Paper Weights

Table 1-2: Recommended Paper Weights

Number of Parts	Recommended Paper Weight	Carbon Insert [†] Sheet Weight
1	56 g/m ² (15 lbs)	—
2, 3 or 4	50 g/m ² (13.5 lbs)	19 g/m ² (8 lbs)
5 or 6	45 g/m ² (12 lbs)	19 g/m ² (8 lbs)

1.4.3 Print Speeds

Print speeds are quoted in lines per minute (LPM) with the printer set at 6 LPI, for each available combination of font and horizontal pitch in characters per inch.

Table 1-3: Print Speeds

Font	Horizontal Pitch (CPI)			
	5, 6.67, 8.35	10	12, 13.3, 15	16.7
DP Uppercase only	See note	300	300	147
DP Upper and Lowercase	See note	240	240	105
NLQ Uppercase only	See note	82	82	147
NLQ Upper and Lowercase	See note	65	65	105
OCR-A Uppercase only*	—	65	—	—
OCR-B Uppercase only*	—	65	—	—

[†]The OCR-A and -B fonts are available in uppercase only.

Note

The print speeds for the 5, 6.67, and 8.35 CPIs are at least 50 per cent of the print speeds of the CPIs from which they are created, that is 10, 13.3, and 16.7 CPIs.

1.4.4 Resident Fonts

Table 1-4: Resident Fonts

Font	Horizontal Pitch (CPI)		
	5, 6.67, 8.35	10	12, 13.3, 15, 16.7
Data Processing	Yes	Yes	Yes
NLQ	Yes	Yes	Yes
OCR-A	NLQ	Yes	NLQ
OCR-B	NLQ	Yes	NLQ

"Yes" indicates that the horizontal pitch is available in the current font.

"NLQ" indicates that when either OCR-A or OCR-B font is selected, and a horizontal pitch other than 10 CPI is selected, the NLQ font is substituted automatically. If the horizontal pitch is subsequently changed to 10 CPI, the printer will return to the selected OCR font.

1.4.5 Resident Character Sets

The resident character sets are:

- Digital Supplemental
- U.S. ASCII
- ISO Great Britain
- Digital Holland
- Digital Finland
- ISO France
- Digital Technical
- VT100 Special Graphics
- Digital French Canada
- ISO Germany
- ISO Italy
- JIS Roman (Japan)
- Digital Norway/Denmark
- ISO Spain
- Digital Sweden
- Digital Switzerland
- ISO Norway/Denmark
- Digital Portugal

The complete character sets are given in Appendix A.

Chapter 2

PRINTER CONTROL STRAP CONFIGURATION

2.1 Printer Control Straps

The printer control straps are software switches that allow modification of the basic printer functions usually controlled by hardware switches or jumpers. This section shows how to print the configuration status of the printer and how to access and reconfigure the printer control straps from the control panel. Section 2.2 gives descriptions of the printer control straps and the factory settings.

2.1.1 Configuration Status Printout

With power applied and the printer in the off-line mode (printer display [O F L]), press the (1) (PRG) key. The printer display changes to [P r o], then a current configuration status (see Figure 2-1) is printed.

Figure 2-1: Factory Set Configuration Status Printout

THE PRESENT CONFIGURATION IS: (44A513016 SY - 44A513017 IM)
FIRMWARE REVISION LEVEL V1.31.000-CSS

1. Font:
Style - 44A513017 Dataprocessing
CPI - 10 CPI
Country - US ASCII
Mode - Normal
Horizontal Expansion - X1
Vertical Expansion - X1
2. LPI - 6 lpi
3. Forms Control (lines):
Form Length - 66
Top Margin - 01
Bottom Margin - 66
4. Interface Control:
Interface Type - Serial
Input buffer length 3840
Interface Straps A:
0 1 2 3
12345678901234567890123456789012
0000100000000100000000101000001000
Interface Straps B:
0 1 2 3
12345678901234567890123456789012
01000100000000000000000000000000
Speed - 9600
Parity - Even
5. Margin Settings (columns):
Left Margin - None
Right Margin - 132
6. Horizontal Tabs (columns):
009 017 025 033 041 049 057 065 073 081
089 097 105 113 121 129 137 145 153 161
169 177 185 193 201 209 217
7. Vertical Tab stops:
8. Printer Control Straps:
Printer Straps A:
0 1 2 3
12345678901234567890123456789012
000000000000000000000000110001110010
Printer Straps B:
0 1 2 3
12345678901234567890123456789012
00000000000000000000000000000000
Press the number '0' to return to normal operation. To continue
modification select (1-8).

2.1.2 Printer Control Straps

To select the Printer Control Straps menu, press key (8). The printer will print the menu shown in Figure 2-2.

Figure 2-2: Printer Control Straps Selection

```
Printer Control Straps:
0. Exit
1. Printer Straps A
2. Printer Straps B
```

2.1.2.1 Exit (0)

Pressing key (0) at this time will return the printer to the off-line mode (printer will display [O F L]) and result in a printout of the following message:

```
End of Program Mode
```

If the key is pressed after making the changes, the new configuration is printed out.

2.1.2.2 Printer Straps A or Printer Straps B

Let us assume that configuration status printout (see Figure 2-1) shows strap B25 is set to a 0 (strap OUT), and we want to set it to a 1 (strap IN). Press key (2) as defined in Figure 2-2 to access the printer straps B. The printer responds with a front panel display of [3 3 o] and prints the message shown in Figure 2-3.

Figure 2-3: Printer Control Strap Configuration Instruction

```
Straps:
0. Exit
1. Strap 'IN'
2. Strap 'OUT'
3. Forward Without Change
4. Reverse Without Change
```

While the front panel display numbers the A Straps 01 to 32 and the B straps 33 to 64, the configuration status printout numbers both A and B straps 1 to 32. The i or o following the strap number in the front panel display defines that strap's setting (o for OUT and i for IN). See Table

2-1 for a cross reference between display and printout numbering of the printer control straps.

Table 2-1: Printer Control Straps Cross Reference Table

Paper Printout				
Strap "A"	0	1	2	3
- Numbering	12345678901234567890123456789012			
- Setting	yyyyyyyyyyyyyyyyyyyyyyyyyyyyyyyyyy			
	y = 1 or 0			
7 Segment Display	000000000011111111112222222222333			
Strap "A"	12345678901234567890123456789012			
Setting*	xxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxx			
Paper Printout				
Strap "B"	0	1	2	3
- Numbering	12345678901234567890123456789012			
- Setting	yyyyyyyyyyyyyyyyyyyyyyyyyyyyyyyyyy			
	y = 1 or 0			
7 Segment Display	333333344444444444555555555566666			
Strap "B"	34567890123456789012345678901234			
Setting*	xxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxx			
*x = i or o				

Table 2-1 shows that printer control strap B25 on the printout is equivalent to the printer control strap 57 displayed on the front panel. Advance the display strap number [3 3o] to [5 7 o] by pressing key (3) until [5 7 o] is displayed. Change the strap setting from [5 7 o] (strap 57 OUT) to [5 7 i] (strap 57 IN) by pressing key (2), observe the "o" following the "57" has been replaced by an "i", pressing key (1) changes "i" to "o".

To verify the change has been sent to non-volatile memory, press key (0). The printer responds with a printout of the printer control straps shown in Figure 2-4, showing that the printer control strap B25 setting has been changed to a 1 (strap B25 IN).

Figure 2-4: Printer Control Strap Verification

```
Printer Control Straps:

Printer Straps A:
01 2 3
12345678901234567890123456789012
00000000000000000000000000000000
Printer Straps B:
01 2 3
12345678901234567890123456789012
00000000000000000000000000000000
```

Press the number '0' to return to normal operation. To continue modification select (1-9).

2.1.2.3 Exit

If all required changes to the printer control straps have been verified, pressing key (0) will return the printer to the off-line mode (printer will display [O F L]) and print the following message:

End of Program

2.2 Printer Control Strap Descriptions

This section provides functional descriptions and factory settings (marked with an asterisk) of the printer straps A and B. Factory settings of the printer control straps taken from the configuration status menu are provided in Figure 2-5. Functional descriptions of the printer control straps are given in Table 2-2.

Figure 2-5: Printer Control Strap Factory Setting

```
Printer Control Straps:

Printer Straps A:
01 2 3
12345678901234567890123456789012
00000000000000000000000000000000
Printer Straps B:
01 2 3
12345678901234567890123456789012
00000000000000000000000000000000
```

Table 2-2: Printer Control Strap Functional Descriptions

Strap	Function and Description
A1-A16	Not Assigned
A17	0 (OUT)* selects LG31 product ID 1 (IN) selects LG01 product ID
A18- A20	Not Assigned
A21	0 (OUT)—DISABLE LINE FEED TO SLEW CONVERSION Paper advances one line feed at a time. 1 (IN)*—ENABLE LINE FEED TO SLEW CONVERSION When strap 21 is IN, consecutive line feeds, or line feeds preceded by carriage returns, are stored in a buffer until other characters are received. At that point, all accumulated line feed commands are performed as a single paper slew of length equal to that of the line feeds if performed separately. The result is an increase in throughput which may be significant in many applications. If line feeds totaling more than 22 in are received, a slew will be performed each time the accumulation reaches 22 in, and the line counter will be reset to allow for the receipt of more line feeds.
A22	0 (OUT)*—DISABLE SLEW TRUNCATION AT TOP OF FORM 1 (IN)—ENABLE SLEW TRUNCATION AT TOP OF FORM Allows the paper to slew no farther than the next Top Margin or first form boundary (if Top Margin is not in effect).
A23	1 (IN)—NLQ font underline reset to baseline.
A24	0 (OUT)*—PRINTER COMES UP OFF LINE AFTER SELF TEST Printer goes to the OFF LINE condition after termination of self test. 1 (IN)—PRINTER COMES UP ON-LINE AFTER SELF TEST Printer goes to the ON LINE condition after termination of self test. Note that the above conditions apply to self test initiated at power-up, following test print or printer initialization. Regardless of the switch setting, the printer will go to the ON LINE condition after a host-initiated self test.
A25	Not Assigned

Table 2-2 (Cont.): Printer Control Strap Functional Descriptions

Strap	Function and Description
A26	0 (OUT) - DISABLE PAPER MOTION KEYS WHEN ON LINE Paper motion keys (Form Feed, Line Feed, and Paper Rev) are disabled when the printer is on-line. 1 (IN)* - ENABLE PAPER MOTION KEYS WHEN ON LINE The paper motion keys (Form Feed, Line Feed, and Paper Rev) are enabled when the printer is on-line. Response to the keys will not occur if the printer is printing or communicating with the host.
A27	0 (OUT) - DISABLE AUTO WRAP A line of data exceeding the right margin will be printed on that line up to the right margin, but the data exceeding the right margin is truncated. 1 (IN)* - ENABLE AUTO WRAP A line of data exceeding the right margin will be printed on that line up to the right margin. Any data exceeding the right margin is wrapped around on the next line.
A28	0 (OUT) - DISABLE LINEFEED/NEW LINE MODE (LNM) This turns off the line feed/new line mode. A line feed character advances the paper one line. The active column does not move. 1 (IN)* - ENABLE LINEFEED/NEW LINE MODE (LNM) This turns on the line feed new line mode. A line feed character advances the paper one line and returns the active column to the left margin. Note that the setting of this strap (IN or OUT) is ignored if switch A29 (below) is set IN.
A29	0 (OUT)*—DISABLE CARRIAGE RETURN/NEW LINE The carriage return/new line mode is turned off. A carriage return character returns the active column to the left margin without advancing to a new line. 1 (IN)—ENABLE CARRIAGE RETURN/NEW LINE The carriage return/new line mode is turned on. A carriage return character returns the active column to the left margin and advances the page one line.

Table 2-2 (Cont.): Printer Control Strap Functional Descriptions

Strap	Function and Description
A30	0 (OUT)*—ENABLE DELETE The delete character prints a checkerboard pattern. 1 (IN)—DISABLE DELETE The delete character is ignored.
A31	1 (IN)—DP font underlined raised to baseline.
A32	0 (OUT)* DISABLE HEX DUMP MODE The characters are processed normally. 1 (IN) - ENABLE HEX DUMP MODE All data (including control codes and escape sequences) will be printed in hexadecimal format. HEX dump allows program debugging and system analysis of the data received by the printer.
B1-B32	Not Assigned

[illegible][illegible]

Chapter 3

INTERFACE CONFIGURATION

3.1 Introduction

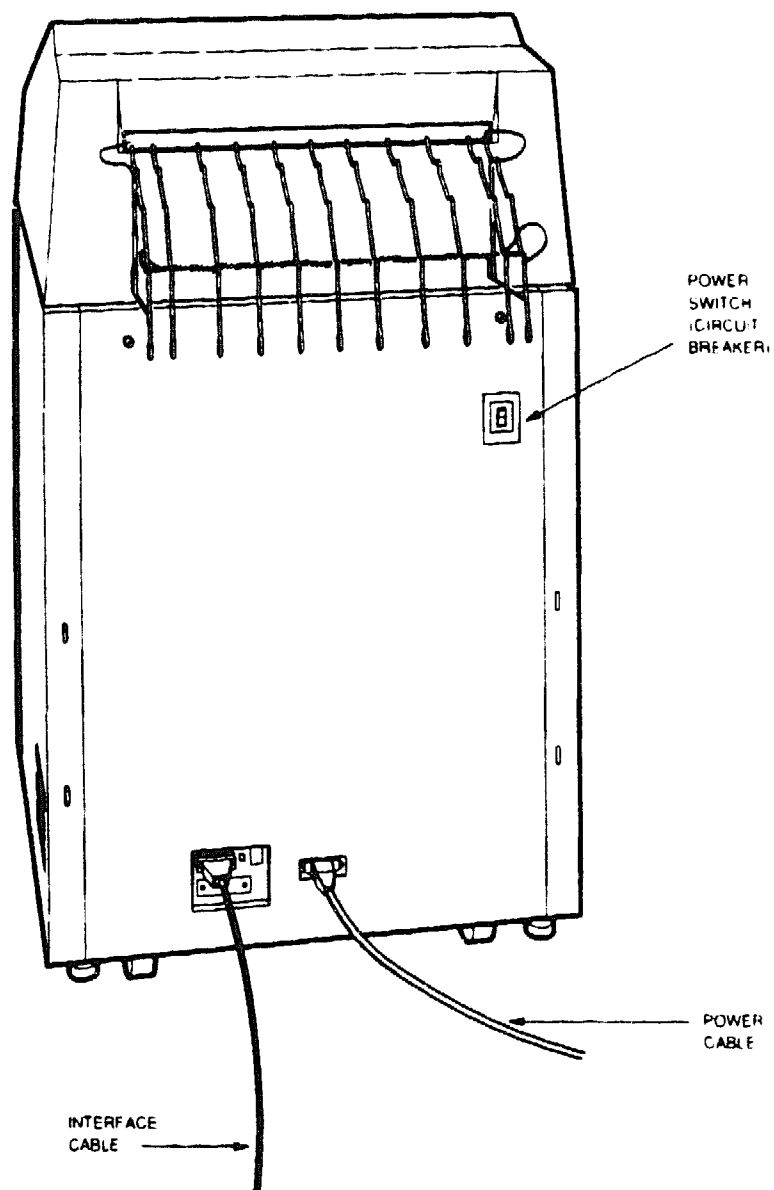
The LG31 printer uses an RS-232-C serial interface. This interface is compatible with other Digital serial printer interfaces. Connection of the host to the printer is made at the serial interface connector located at the back of the printer (see Figure 3-1).

Section 3.2 gives descriptions of the serial interface, pin numbers, and signals. Section 3.3 describes the XON/XOFF protocol and input buffer processing. This chapter also shows how to access and reconfigure the interface straps in Section 3.4, and provides descriptions of the interface control straps and the factory settings in Section 3.5.

3.2 Serial Interface

This section describes the serial interface connector (see Figure 3-2), defines the interface pin assignments, and describes the interface signals, the input buffer, and the XON/XOFF protocol.

Figure 3-1: Serial Interface Connector Location

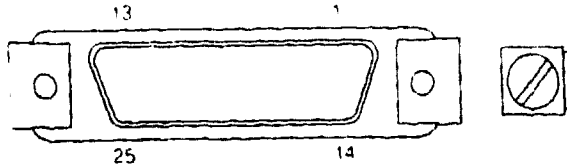


3-2 INTERFACE CONFIGURATION

3.2.1 Serial RS-232-C Connector

Figure 3-2 shows the 25-pin serial RS-232-C interface connector.

Figure 3-2: Serial RS-232-C Interface Connector



RE UK00969A 8"

3.2.2 Pin Assignments and Signal Descriptions

Table 3-1 defines the serial interface pin numbers, the mnemonic, the source, and the description of the signals.

1. Pin 3 (RX) is the primary data input line carrying serial data from the host to the printer. The printer accepts the data as long as it is on line and for one second after the printer has been placed in the off-line state. A negative level is a Mark and a positive level is a Space. When released, the line level should be in a Mark condition.
2. When XON/XOFF protocol is used, the parity must be set to match the data source.
3. DSR is strap-dependent; CTS is not strap-dependent. Regardless of how the printer is strapped, the host may always use CTS to inhibit.
4. CTS must be positive or lead open-circuit for XON/XOFF protocol. For this protocol RTS or DTR cannot be tied to CTS.

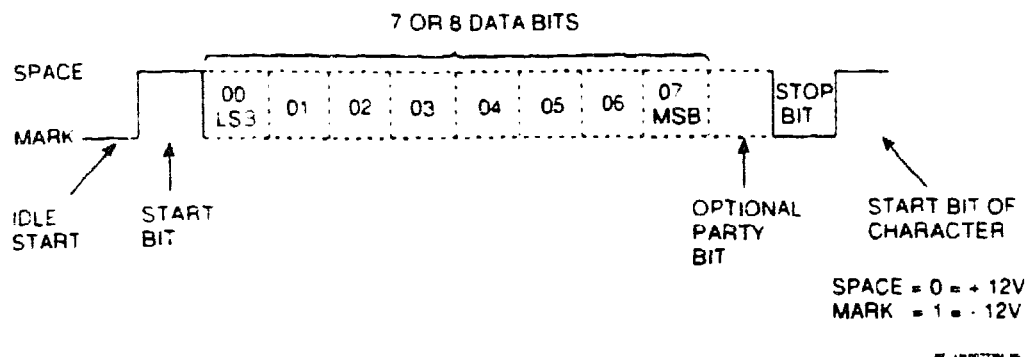
Table 3-1: Serial Pin Assignments and Descriptions

Pin number	Mnemonic	Source	Description
1	Protective Ground (PGND)	Common	Protective Ground.
2	Transmitted Data (TX)	Printer	Serial encoded data sent to the host.
3	Received Data (RX)	Host	Serial encoded data sent to the printer.
4	Request to Send (RTS)	Printer	When set the printer is on-line.
5	Clear to Send (CTS)	Host	Printer transmission is not inhibited.
6	Data Set Ready (DSR)	Host	Printer is ready to send.
7	Signal Ground (SGND)	Common	Logic Common.
11	Secondary Request to Send (SCA-1)	Printer	Printer is ready to send.
19	Secondary Request to Send (SCA-2)	Printer	Printer is ready to send.
20	Data Terminal Ready (DTR)	Printer	Indicates when printer is ready to receive data.

3.2.3 Serial Data Format

The serial interface requires that data is transmitted in a bit-serial, asynchronous character format. Figure 3-3 shows serial data format for host to printer and printer to host communications.

Figure 3-3: Serial Data Format



3.3 Input Buffer Control

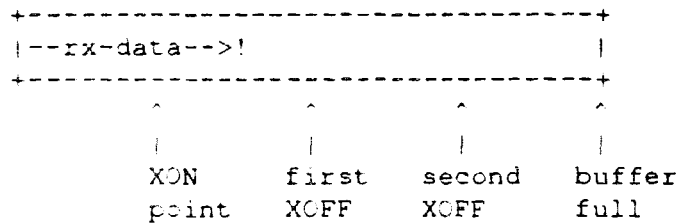
The LG31 uses XON/XOFF protocol and a 2 Kbyte input buffer to avoid input buffer data overflow.

3.3.1 XON/XOFF Protocol

To avoid input buffer overflows the LG31 printer uses XON/XOFF protocol to synchronize data exchange.

After power-up, the printer is set to Ready and it sends one XON control character, signaling that it is ready to receive data. The printer constantly monitors the number of characters in the input buffer. When the input buffer fills to within 150 characters of full (the first XOFF point), the printer sends an XOFF control character, signalling the data source to pause temporarily. Meanwhile, the printer continues to take characters from the input buffer for printing or processing. When data remaining in the input buffer drops back to 50 characters from empty (the XON point), the printer sends an XON control character, signalling that transmission may resume.

LG31 Input Buffer (FIFO)



The host transmits characters to the printer which are stored in the printer buffer. When the number of characters in the buffer reach certain points, the printer transmits XOFF characters to control the flow of data. The transmission of these XOFF characters occur when:

1. The number of characters in the input buffer reaches the first XOFF point (150 characters from full).
2. The number of characters in the input buffer reaches the second XOFF point (100 characters from full). This may occur if the first XOFF had been ignored by the host.

If the host continues to send the characters after the second XOFF and the input buffer becomes full, the incoming data is disregarded and an error condition occurs.

Having sent the XOFF(s) to host, the printer continues to process the data in the input buffer. When the data decreases to 50 characters from empty (XON point), the printer sends a XON character to the host signifying that it is ready to receive more data.

3.3.2 Input Buffer Processing

All characters sent to the printer are temporarily stored in the standard 2 Kbyte (2048 characters) input buffer for further processing.

When the printer is in the Ready state and processing data from the input buffer, it moves characters to the print buffer. The processed data in the print buffer is printed when one of the following conditions are met:

1. Receipt of a line terminator (<LF>, <FF>, <VT>, or <CR>).
2. Autowrap has been enabled and the print data active position is past the right margin.

3. Approximately 500 ms elapse without receipt of print data from the host.

When the received data is incorrect, the printer replaces each character with the error character (reverse question mark) when printing.

Unlike all other control codes and control sequences, the Device Status Request (DSR) sequence is processed immediately after it is received.

3.4 Interface Control

The interface control straps are software switches allowing the user to modify interface functions usually controlled by hardware switches or jumpers. This section will show how to get a printout of the configuration status, and how to access and reconfigure the interface straps.

3.4.1 Configuration Status Printout

With power applied and the printer in the OFF-LINE mode (printer display is [O F L]), press the (1) PRG key. The printer display will change to [P r o], then print a current configuration status (see in Figure 3-4).

Figure 3-4: Factory Set Configuration Status Printout

THE PRESENT CONFIGURATION IS: (44A513016 SY - 44A513017 IM)
FIRMWARE REVISION LEVEL V1.31.000-CSS

1. Font:
Style - 44A513017 Dataprocessing
CPI - 10 CPI
Country - US ASCII
Mode - Normal
Horizontal Expansion - X1
Vertical Expansion - X1
2. LPI - 6 lpi
3. Forms Control (lines):
Form Length - 66
Top Margin - 01
Bottom Margin - 66
4. Interface Control:
Interface Type - Serial
Input buffer length 3840
Interface Straps A:
0 1 2 3
12345678901234567890123456789012
00001000000010000000101000001000
Interface Straps B:
0 1 2 3
12345678901234567890123456789012
01000100000000000000000000000000
Speed - 9600
Parity - Even
5. Margin Settings (columns):
Left Margin - None
Right Margin - 132
6. Horizontal Tabs (columns):
009 017 025 033 041 049 057 065 073 081
089 097 105 113 121 129 137 145 153 161
169 177 185 193 201 209 217
7. Vertical Tab stops:
8. Printer Control Straps:
Printer Straps A:
0 1 2 3
12345678901234567890123456789012
000000000000000000000000110001110010
Printer Straps B:
0 1 2 3
12345678901234567890123456789012
00000000000000000000000000000000
Press the number '0' to return to normal operation. To continue
modification select (1-8).

3.4.2 Interface Type Control

To select the Interface Control menu, press key (4). The printer will print the menu shown in Figure 3-5.

Figure 3-5: Interface Control Selection

```
Interface Control
0.  Exit
1.  Interface Type
2.  Interface Straps A
3.  Interface Straps B
4.  Speed
5.  Parity
```

3.4.2.1 Exit

Pressing key (0) at this time will return the printer to the off-line mode (printer will display [O F L]) and result in a printout of the following message:

```
End of Program Mode
```

3.4.2.2 Interface Type

The RS-232-C is the only interface available for the LG31 Printer. However, pressing key (1) will result in the printout shown in Figure 3-6.

Figure 3-6: Interface Type Selection

```
0.  Exit
1.  Interface Type
```

If you press key (0), the printer will respond with a printout verifying the Interface Type in Figure 3-7.

Figure 3-7: Interface Type Verification

Interface Type - Serial

Press the number '0' to return to normal operation. To continue modification select (1-9).

If you press key (1), the printer will respond with the following printed message:

Interface Control

- 0. Exit
- 1. Serial

Because the serial interface is the only interface available and pressing key (1) to select the serial interface would serve no function, press key (0) to Exit. The printer will respond with

Interface Type - Serial

3.4.2.3 Interface Strap

A description of what each of the interface straps (A and B) do is given in Table 3-3. The following example describes how to change the straps. Press key (2), defined in Figure 3-5 as Interface Straps A. The printer responds with a front panel display of [0 1 o] and prints the message shown in Figure 3-8.

Figure 3-8: Strap Configuration Selection

- Straps:
0. Exit
 1. Strap 'IN'
 2. Strap 'OUT'
 3. Forward Without Change
 4. Reverse Without Change

On the front panel display, the strap numbers plus a letter (**i** or **o**) are displayed. The A straps are numbered 1 to 32 and the B straps are numbered 33 to 64. The letter **i** or **o** following the strap number in the front panel display defines that strap's setting (**o** for **OUT** and **i** for **IN**). See Table 3-2 for a cross reference between display and printout numbering of the interface control straps.

Table 3-2: Interface Strap Cross Reference Table

Printout				
Strap "A"	0	1	2	3
Numbering	12345678901234567890123456789012			
Display	0000000001111111112222222222333			
Strap "A"	12345678901234567890123456789012			
Numbering*	xxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxx			
Printout				
Strap "B"	0	1	2	3
Numbering	12345678901234567890123456789012			
Display	3333333444444444555555555566666			
Strap "B"	34567890123456789012345678901234			
Numbering*	xxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxx			

*x = i or o indicates configuration as shipped from the factory

Assume that configuration status printout (Figure 3-4) shows strap A15 is set to 0 (strap **OUT**), and you want to set it to 1 (strap **IN**).

Table 3-2 shows printer control strap A15 on the printout is equivalent to the printer control strap 15 displayed on the front panel. To change the strap setting from [1 5 o] (strap 15 **OUT**) to [1 5 i] (strap 15 **IN**), press key (2) and observe the "o" following the "15" has been replaced by an "i", pressing key (1) changes "i" to "o".

To verify the change has been sent to non-volatile memory, press key (0). The printer responds with a printout of the interface control straps and their settings, as shown in Figure 3-9. The printout shows interface strap A10 setting has been changed to a 1 (interface strap A10 IN).

Figure 3-9: Interface Control Strap Verification

Interface Straps A:

```
0 1 2 3
12345678901234567890123456789012
00000000010000000000000000000000
```

Interface Straps B:

```
0 1 2 3
12345678901234567890123456789012
00000000000000000000000000000000
```

Press the number '0' to return to normal operation.
To continue modification select (1-8).

3.4.2.4 Speed (Baud Rate)

Press key (4) to obtain the printout shown in Figure 3-10.

Figure 3-10: Speed Selection

Speed -

- 0. Exit
- 1. 110
- 2. 300
- 3. 600
- 4. 1200
- 5. 1800
- 6. 2400
- 7. 4800
- 8. 9600
- 9. 19200

The speed (bits-per-second) shown above can be selected by the user to configure the LG31 serial interface. The higher the speed, the faster the data exchange between printer and host. However the speed must be set to match the host. The factory speed setting is 9600.

If you wish to select a speed other than 9600, press the corresponding key; (7) for example, to set the speed to 4800. Verify the new speed has been sent to non-volatile memory by pressing key (0). The printer should respond with a message verifying the speed has been changed to 4800 (Figure 3-11).

Figure 3-11: Speed (Baud Rate) Verification

```
Speed - 4800
Press the number '0' to return to normal operation. To continue
modification select (1-8).
```

3.4.2.5 Parity (Select 5)

Pressing key (5) will result in the printout shown in Figure 3-12.

Figure 3-12: Parity Selection

When Interface Strap B6
is OUT

Parity -

- 0. Exit
- 1. Even
- 2. Odd
- 3. Space
- 4. Mark

When Interface strap B6
is IN (factory setting)

Parity -

- 0. Exit
- 1. Even
- 2. Odd

Note

The space and mark options are available in 7-bit mode only. In 8-bit mode, these options are not selectable, and are not printed.

The parity (transmission error checking) options above can be selected by the user to configure the LG31 serial interface. The parity option selected must match the the parity option of the host.

Note

The parity options are disabled at the factory by setting interface strap A29 (front panel display is 29) to **IN**. Parity checking may be enabled by setting the strap to **OUT** (parity enabled).

If parity checking is enabled and you wish to change the parity option, press the corresponding key (2). For example, to select odd parity, verify the odd parity checking option has been sent to non-volatile memory by pressing the (0) key. The printer should respond with a message verifying the parity option has been changed to ODD (see Figure 3-13).

Figure 3-13: Parity Verification

Parity - Odd
Press the number '0' to return to normal operation. To continue
modification select (1-8).

3.4.2.6 Exit

If all the required changes to the interface straps have been verified, pressing key (0) will return the printer to the off-line mode (printer will display [O F L]) and print the following message:

End of Program Mode

3.5 Interface Control Strap Descriptions

This section provides functional descriptions and factory settings of the interface straps A and B. Factory settings of the interface control straps taken from the configuration status printout is provided in Figure 3-14. Functional descriptions of the A and B interface control straps are provided in Table 3-3.

Figure 3-14: Interface Control Straps Factory Settings

Interface Control:	0	1	2	3
Interface Type - Serial	12345678901234567890123456789012			
Interface Straps A:	00000000000000000000000000000000			
Interface Straps B:	0	1	2	3
	12345678901234567890123456789012			
	00000100000000000000000000000000			
Speed -	9600			
Parity -	Even*			

* Parity is disabled at interface strap B2.

Table 3-3: A and B Interface Strap Descriptions

Interface Strap	Factory Setting	Strap Function When Set to 1 (IN)
A1 - A3	Not Assigned	
A4	0 (OUT)	Enable READY/BUSY by way of SCA (pins 11 and 19). The lines are 12 V for READY and -12 V for BUSY .
A5	1 (IN)	Enable READY/BUSY by way of the <XON> and <XOFF> codes. <XON> is sent to the computer for READY (BUSY cleared) and <XOFF> is sent to the computer for BUSY .
A6	0 (OUT)	Enable READY/BUSY at the transmission of a 200 ms break. The 200 ms break is sent for BUSY , nothing is sent for READY .
A7	0 (OUT)	Enable READY/BUSY by way of DTR (pin 20). The line is 12 V for READY and -12 V for BUSY .
A8	0 (OUT)	Enable READY/BUSY by way of RTS (pin 4). The line is 12 V for READY and -12 V for BUSY .
A9 - A11	Not Assigned	
A12	0 (OUT)	Enable NO FAULT/FAULT by way of SCA (pins 11 and 19). The lines are 12 V for NO FAULT and -12 V for FAULT .
A13	1 (IN)	Enable NO FAULT/FAULT by way of the <XON> and <XOFF> codes. <XON> is sent to the computer for NO FAULT (FAULT cleared) and <XOFF> is sent to the computer for FAULT .
A14	0 (OUT)	Enable NO FAULT/FAULT at the transmission of a 200 ms break. The 200 ms break is sent for FAULT , nothing is sent for NO FAULT .
A15	0 (OUT)	Enable NO FAULT/FAULT by way of DTR (pin 20). The line is 12 V for NO FAULT and -12 V for FAULT .

Table 3-3 (Cont.): A and B Interface Strap Descriptions

Interface Strap	Factory Setting	Strap Function When Set to 1 (IN)
A16	0 (OUT)	Enable NO FAULT/FAULT by way of RTS (pin 4). The line is 12 V for NO FAULT and -12 V for FAULT .
A17 - A19		Not Assigned
A20	0 (OUT)	Enable ONLINE/OFFLINE by way of SCA (pins 11 and 19). The lines are 12 V for ONLINE and -12 V for OFFLINE .
A21	1 (IN)	Enable ONLINE/OFFLINE by way of the <XON> and <XOFF> codes. <XON> is sent to the computer for ONLINE (FAULT cleared) and <XOFF> is sent to the computer for OFFLINE .
A22	0 (OUT)	Enable ONLINE/OFFLINE at the transmission of a 200 ms break. The 200 ms break is sent for OFFLINE nothing is sent for ONLINE .
A23	0 (OUT)	Enable ONLINE/OFFLINE by way of CD (pin 20). The line is 12 V for ONLINE and -12 V for OFFLINE .
A24	0 (OUT)	Enable ONLINE/OFFLINE by way of CA (pin 4). The line is 12 V for ONLINE and -12 V for OFFLINE .
A25	Not Assigned	
A26	0 (OUT)	Enable ETX/ACK Protocol — The computer sends a block of data up to 1500 bytes long terminating it with <ETX> . When the printer has processed the data, it sends <ACK> to the computer indicating it is ready to receive more data. The computer cannot send data until it receives <ACK> from the printer. This protocol can be used by itself or in combination with any of the protocols previously described.

Table 3-3 (Cont.): A and B Interface Strap Descriptions

Interface Strap	Factory Setting	Strap Function When Set to 1 (IN)
A27	0 (OUT)	Reverse SCA Polarity — If the interface is configured to indicate status by way of SCA (pins 11 and 19), normal status will set the SCA lines to -12 V and a fault status will set the SCA lines to 12 V.
A28	0 (OUT)	Reverse DTR Polarity — If the interface is configured to indicate status by way of DTR (pin 20), normal status will set DTR to -12 V and a fault status will set DTR to 12 V.
A29	1 (IN)	Disable Parity Check—Sets the serial interface to accept any parity and not report parity errors.
A30	0 (OUT)	Enable Two Stop Bits—Sets the serial interface to require two stop bits to terminate a transmitted character. Typically two stop bits are used at the 110 baud transmission rate.
A31	0 (OUT)	Disable Printer Transmission—Inhibits the serial interface from transmitting data. The XON/XOFF BREAK , and ETX/ACK protocols cannot be used when this switch is IN because they require the interface to transmit.
A32	0 (OUT)	Reverse RTS Polarity — If the interface is configured to indicate status by way of CA (pin 4), normal status will set CA to -12 V and a fault status will set CA to 12 V.
B1	Not Assigned	
B2	1 (IN)	Disable the Parity Bit—Sets the serial interface to omit the parity bit when transmitting data to the computer.

Table 3-3 (Cont.): A and B Interface Strap Descriptions

Interface Strap	Factory Setting	Strap Function When Set to 1 (IN)
B3	0 (OUT)	Disable Auto Input Buffer Expansion—If the 8 KByte input buffer expansion option is installed, the input buffer is limited to 2048 Bytes of usable RAM. If the switch is OUT , all available RAM (10,240 Bytes) is used as the input buffer. This switch is ignored if the option is not installed.
B4	0 (OUT)	Disable Printer Transmission—The serial interface will not transmit if DSR (pin 6) is set to -12 V (OFF) by the computer. Use this switch with care if the XON/XOFF , BREAK , or ETX/ACK protocol is active, because the the printer must be able to transmit for these protocols to operate. Regardless of the switch setting, the computer can inhibit the printer transmission by setting CB (pin 5) to -12 V.
B5	0 (OUT)	Replace Underline With Carriage Return — Replaces the underline character (5FH) with a carriage return control code (0DH).
B6	1 (IN)	Select 7- or 8-Bit Data—With the strap set to 1 (IN), the serial interface accepts and processes 7-bit and 8-bit data. If the strap is set to 0 (OUT), the interface will process all data as 7-bit data.
B7 - B32	Not Assigned	

Chapter 4

CHARACTER PROCESSING

4.1 General

This chapter describes how the LG31 processes printable and control characters when operating in the text mode. Control characters are interpreted by the LG31 printer as commands or as parts of control sequences. They affect how the LG31 processes, sends, and prints characters.

4.2 Coding Standards

The LG31 processes characters according to the American National Standards Institute (ANSI) standard X3.4-1977. The ANSI standard is based on character category, either printable or control. Categories are defined by the American Standard Code for Information Interchange (ASCII).

4.3 7-Bit and 8-Bit Environments

The LG31 is set to send and receive 7- or 8-bit data through the interface control straps (see Chapter 3). In a 7-bit environment, a total of 128 control and printable characters codes are available (see Figure 4-1). In an 8-bit environment a total of 256 control and printable codes are available (see Figure 4-2).

There are two sets of control characters, C0 and C1. C0 consists of the 7-bit control characters that is, the characters from 00H to 1FH. C1 consists of the 8-bit control characters, that is characters from 80H to 9FH. C1 characters may only be used in an 8-bit environment.

Two sets of printable characters may be used at one time. The LG31 stores the two active sets in areas called GL (graphics left) and GR (graphics right). The GL characters are the 7-bit printable characters. They range from 20H to 7FH. Character 20H is a space and character 7FH is a delete. The delete character may either be printed as checkerboard or be ignored depending on printer strap 30. The GR characters are the 8-bit printable characters. They range from A0H to FEH. The GR characters may only be printed in an 8-bit environment.

Figure 4-1: 7-bit U.S. ASCII Character Set

BITS				COLUMN		1	2	3	4	5	6	7
B7	B6	B5		0								
ROW	B4	B3	B2	B1								
0	0	0	0	0	NUL	DLE	SP	0	@	P	.	p
1	0	0	0	1	SOH	DC1 (XON)	!	1	A	Q	a	q
2	0	0	1	0	STX	DC2	"	2	B	R	b	r
3	0	0	1	1	ETX	DC3 (XOFF)	#	3	C	S	c	s
4	0	1	0	0	EOT	DC4	\$	4	D	T	d	t
5	0	1	0	1	ENQ	NAK	%	5	E	U	e	u
6	0	1	1	0	ACK	SYN	&	6	F	V	f	v
7	0	1	1	1	BEL	ETB	'	7	G	W	g	w
8	1	0	0	0	BS	CAN	(	8	H	X	h	x
9	1	0	0	1	HT	EM	)	9	I	Y	i	y
10	1	0	1	0	LF	SUB	*	:	J	Z	j	z
11	1	0	1	1	VT	ESC	+	;	K	[	k	{
12	1	1	0	0	FF	FS	,	<	L	\	l	
13	1	1	0	1	CR	GS	-	=	M	]	m	}
14	1	1	1	0	SO	RS	.	>	N	^	n	~
15	1	1	1	1	SI	US	/	?	O	_	o	DEL

KEY

ASCII CHARACTERS

ESC

33

27

18

OCTAL

DECIMAL

HEX

Figure 4-2: 8-bit Digital Multinational Character Set

BIT 8	BIT 7	BIT 6	BIT 5	BIT 4	BIT 3	BIT 2	BIT 1	COLUMN								ROW							
								0	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15
0	0	0	0	0	0	0	0	NUL	SP	!	@	A	P	Q	R	S	T	U	V	W	X	Y	Z
1	0	0	0	1	0	0	0	DC1 (XON)	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15
2	0	0	1	0	0	0	0	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17
3	0	0	1	1	0	0	0	DC3 (XOFF)	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15
4	0	0	1	1	1	0	0	EOT	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15
5	0	0	1	1	1	1	0	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16
6	0	0	1	1	1	1	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17
7	0	1	0	0	0	0	0	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18
8	0	1	0	0	0	0	1	BS	CAN	(	)	[	]	^	_	~	DEL	HTS	HT	HT	HT	HT	HT
9	0	1	0	0	1	0	0	HT		)	[	]	^	_	~	DEL	HTS	HT	HT	HT	HT	HT	HT
10	0	1	0	1	0	0	0	LF	SUB	+	,	.	:	;	'	"	DEL	VTS	V	V	V	V	V
11	0	1	0	1	0	1	0	VT	ESC								DEL	PLO	P	P	P	P	P
12	0	1	0	1	0	1	1	FF									DEL	PLU	PL	PL	PL	PL	PL
13	0	1	1	0	0	0	0	CR									DEL	RI	RI	RI	RI	RI	RI
14	0	1	1	0	0	1	0	SO									DEL	SS2	SS	SS	SS	SS	SS
15	0	1	1	0	0	1	1	SI									DEL	SS3	SS	SS	SS	SS	SS
ASCII CONTROL SET								ASCII GRAPHIC CHARACTER SET								DEC MULTINATIONAL CHARACTER SET							
DEC SUPPLEMENTAL CHARACTER SET								DEC SUPPLEMENTAL GRAPHIC SET															

KEY

ASCII CHARACTERS	15
ESC	16
DATA	17
DECIMAL	18
HEX	19

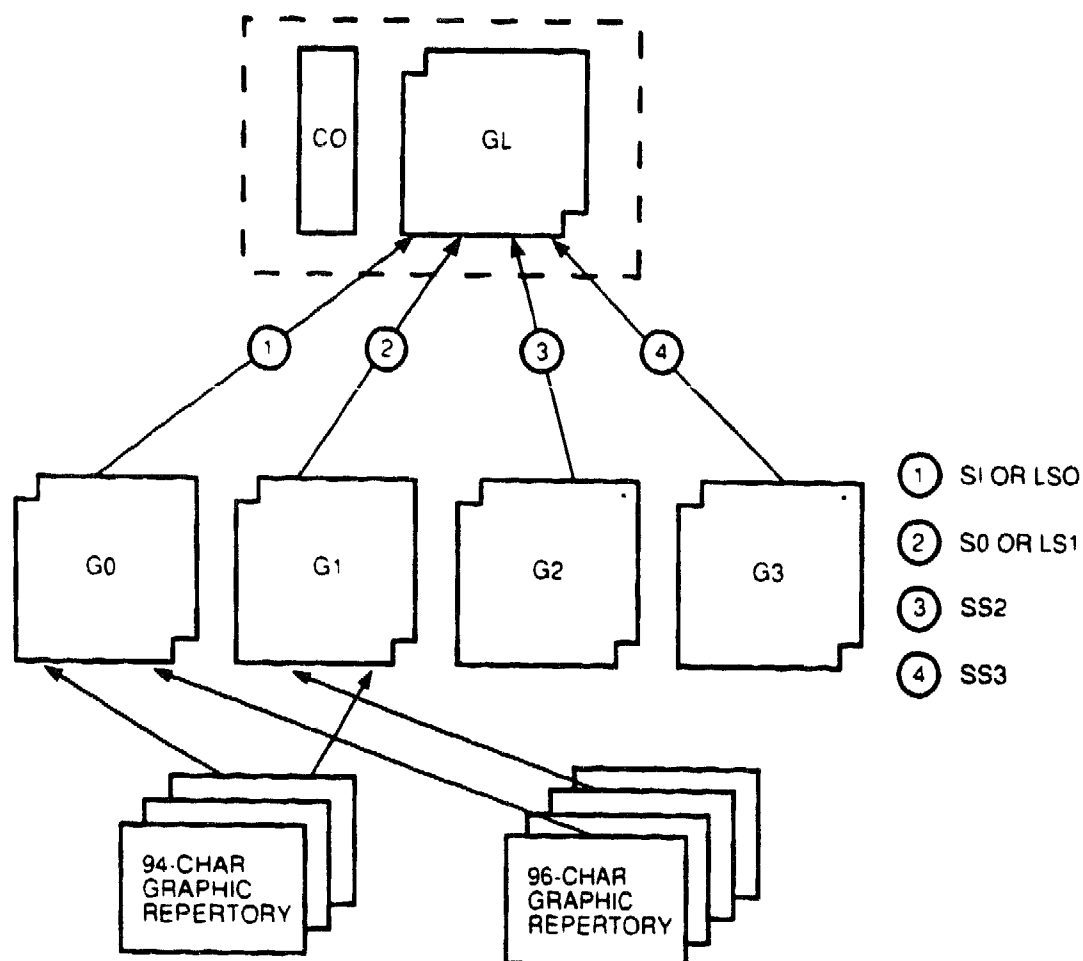
RE UC008486 80

4.4 Character Set Mapping

LG31 allows the use of one **GL** and one **GR** at a time. The **GL** set may be used in a 7-bit environment (see Figure 4-3). In an 8-bit environment, both the **GL** and **GR** may be used (see Figure 4-4).

Printable characters are usually grouped into the two sets. A number of character sets are available in LG31 (see Appendix A). Each of these character sets may be mapped into either **GL** or **GR**. This is done by first designating the required character sets as **G0**, **G1**, **G2**, or **G3**. These **G0** to **G3** sets must then be mapped into either **GL** or **GR** using single and locking shift commands to facilitate the ease of use of more than two sets.

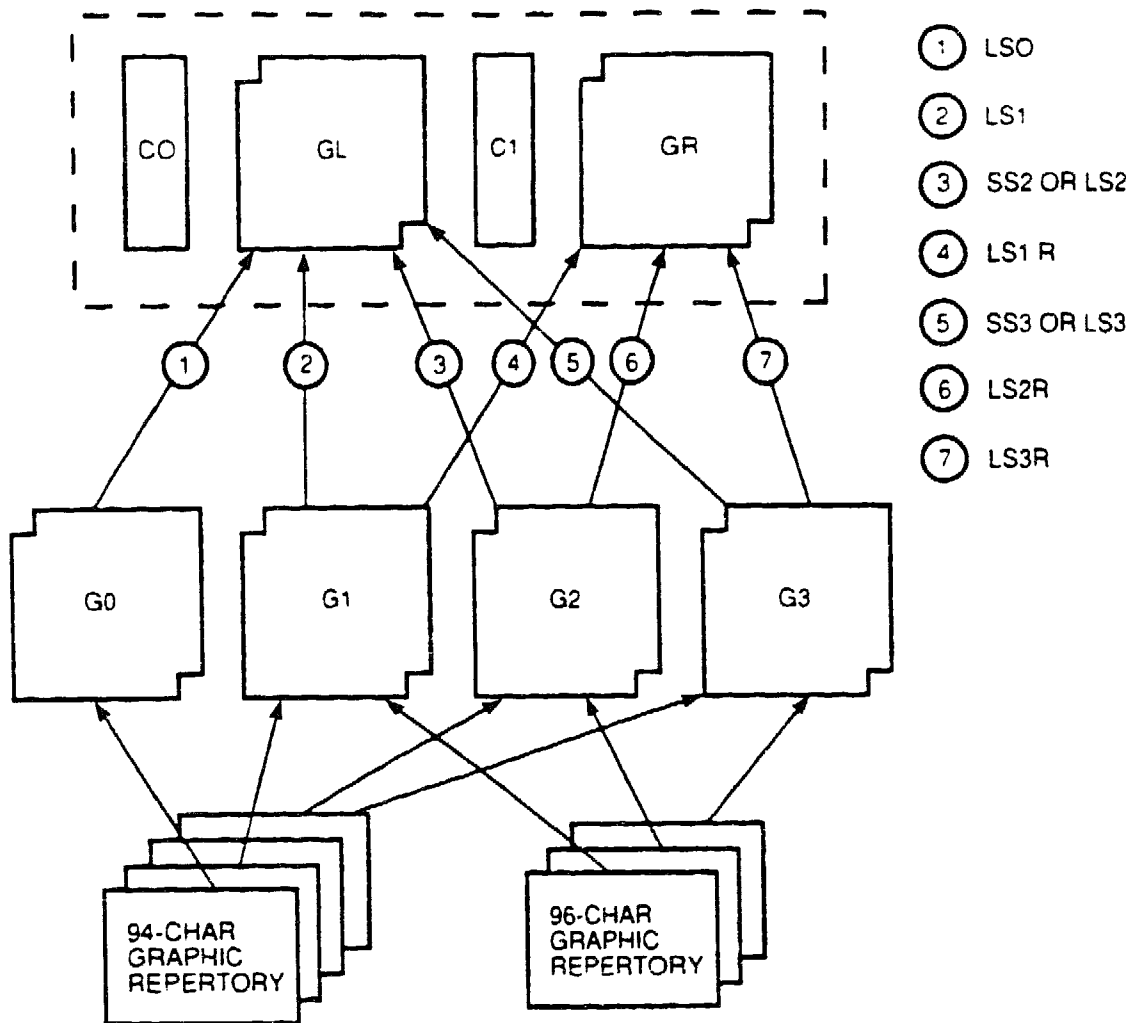
Figure 4-3: Designating and Mapping Character Sets (7-bit Environment)



AF UK0025-1M 89

*SS2 and SS3 affect only the first printable GL character following the single shift sequence. The printer processes non-printable characters (space, sequence, control codes) as usual. The locking shift (LS0, LS1, LS2, LS3, LS1R, LS2R, OR LS3R) remains in effect until another locking shift is received.

Figure 4-4: Designating and Mapping Character Sets (8-bit Environment)



RE UN007/PMW 88

4.5 7-bit Control Characters (C0)

This section describes the function of each of the LG31 C0 control characters.

4.5.1 Bell <BEL>

The <BEL> control character sounds an electronic buzzer for approximately one-half second.

7-bit Control Code: <BEL>

Hex Value: 07

4.5.2 Backspace <BS>

The <BS> control character moves the active line position one column to the left. If the active line position is at the left margin, <BS> is ignored.

7-bit Control Code: <BS>

Hex Value: 08

If the horizontal pitch is changed within a line, <BS> will be implemented according to the new HAI value.

When the active column advances one HAI unit beyond the right margin and a <BS> character is received before another printable character is received, <BS> decreases the active column by one unit of HAI, allowing overprinting at the right margin. However, if the active column is more than one unit of HAI beyond the right margin, the <BS> function is ignored until the active column returns to the printable area.

4.5.3 Horizontal Tab <HT>

The <HT> control character advances the active horizontal tab position to the next preset horizontal tab stop. If horizontal tab stops do not exist, the active position goes to the right margin.

7-bit Control Code: <HT>

Hex Value: 09

At power-up or on receipt of a reset (RIS or DECSTR), horizontal tab positions are set every 8 columns (9, 17, 25, ..., 137). If a horizontal tab stop exists to the right of the the active column, receipt of a <HT> advances the active position to that tab stop.

If no horizontal tab stops exist to the right of the active column and a **<HT>** is received, one of the two actions described below will occur, depending on whether autowrap is enabled or disabled.

When Autowrap is enabled, receipt of **<HT>** sets the active position to the right margin. Only the receipt of a printable character (including the space character) will change the horizontal column position and autowrap (carriage return and line feed).

When Autowrap is disabled, receipt of **<HT>** sets the active position to the right margin. Receipt of printable characters (including the space character) is ignored until the active column position is within the printable area by way of a carriage return or form feed for example.

4.5.4 Line Feed <LF>

The **<LF>** control character advances the active line position to the next line. If the active line is the last printable line on the page, receipt of Line Feed **<LF>** will advance the paper to the first printable line of the next page.

7-bit Control Code: **<LF>**

Hex Value: **0A**

4.5.5 Vertical Tab <VT>

The **<VT>** control character advances the active line position to the vertical tab position.

7-bit Control Code: **<VT>**

Hex Value **0B**

A vertical tab is a pre-selected line setting on a page. At power-up, vertical tabs are set at every line, and receipt of a **<VT>** will act as a line feed **<LF>**. If no vertical tabs remain on the current page, receipt of **<VT>** will perform a form feed **<FF>**.

Vertical tabs are set in the following way:

- Using the **DECSVTS** sequence.
- Using the 8-bit control code, **<VTS>**.

4.5.6 Form Feed <FF>

The <FF> control character advances the active line to the first printable line of the next page and sets the active horizontal print position at column 1.

7-bit Control Code: <FF>

Hex Value: 0C

4.5.7 Carriage Return <CR>

The <CR> control character moves the active print position to the left most margin of the current line.

7-bit Control Code: <CR>

Hex Value: 0D

4.5.8 Shift Out <SO>

The <SO> control character selects the G1 character set as the GL active character set.

7-bit Control Code: <SO>

Hex Value: 0E

4.5.9 Shift In <SI>

The <SI> control character selects the G0 character set as the GL active character set.

7-bit Control Code: <SI>

Hex Value: 0F

4.5.10 Device Control 1/XON <DC1>

The <DC1> control character is ignored if received by the printer. When sent by the printer, it signals to the host that the printer is ready to receive data.

7-bit Control Code: <DC1>

Hex Value: 11

4.5.11 Device Control 3/XOFF <DC3>

When the <DC3> control character sent, it signals the host that the LG31 is not ready to receive data.

7-bit Control Code: <DC3>

Hex Value: 13

This control code is ignored if received.

4.5.12 CAnceL <CAN>

The <CAN> control character can perform one of two functions, depending upon the context:

7-bit Control Code: <CAN>

Hex Value: 18

If the <CAN> control character is received in a sequence, it indicates the sequence is in error and causes the sequence in progress to be ended immediately. Characters following <CAN> are interpreted normally.

If the <CAN> control character received in a Device Control String (DCS), the string is immediately cancelled.

4.5.13 SUBstitute <SUB>

The <SUB> control character can perform one of three functions, depending upon the context.

7-bit Control Code: <SUB>

Hex Value: 1A

If the <SUB> control character is received in a sequence, the sequence is canceled immediately, without execution of the sequence. In addition, <SUB> is interpreted as being in place of a character or characters received in error.

If the <SUB> control character is received during text printing, an the error character (reverse question mark) will be printed.

If the <SUB> control character is received during sixel graphics, <SUB> will be processed as 3FH (Sixel space).

4.5.14 Escape <ESC>

The <ESC> control character introduces an escape control sequence (<ESC> followed by a sequence of printable characters) that control the printer's programmable features.

7-bit control code: <ESC>

Hex Value: 1B

4.6 8-bit Control Codes and Equivalent Escape Sequences

This section describes the function of each of the LG31 C1 control codes and gives a 7-bit equivalent escape sequence.

4.6.1 Forward INDEX <IND>

The <IND> control character moves the active column position to the corresponding column position of the following line.

8-bit Control Code: <IND>

Hex Value: 84

7-bit Escape Sequence: <ESC>D

Hex Value: 1B 44

The <IND> command can move the active position past the page boundary into the next form.

4.6.2 Reverse Index <RI>

The <RI> control character moves the active column position to the corresponding column position of the preceding line.

8-bit Control Code: <RI>

Hex Value: 8D

7-bit Escape Sequence: <ESC>M

Hex Value: 1B 4D

The <RI> command does not cause the active position to be moved beyond the page boundary but stops at the top of form.

4.6.3 Horizontal Tab Set <HTS>

The <HTS> control character sets a horizontal tab stop at the active column.

8-bit Control Code: <HTS>

Hex Value: 88

7-bit Escape Sequence: <ESC>H

Hex Value: 1B 48

4.6.4 Vertical Tab Set <VTS>

The <VTS> control character sets a vertical tab stop at the active column.

8-bit Control Code: <VTS>

Hex Value: 8A

7-bit Escape Sequence: <ESC>J

Hex Value: 1B 4A

4.6.5 Partial Line Down <PLD>

The <PLD> control character moves the active column position to the corresponding column position approximately 3/72 inch down.

8-bit Control Code: <PLD>

Hex Value: 8B

7-bit Escape Sequence: <ESC>K

Hex Value: 1B 4B

The Partial Line Down <PLD> control character is used to position the characters following it as subscripts until returned to the active line using the Partial Line Up <PLU> control character.

4.6.6 Partial Line Up <PLU>

The <PLU> control character moves the active column position to the corresponding column position approximately 3/72 inch up.

8-bit Control Code: <PLU>

Hex Value: 8C

7-bit Escape Sequence: <ESC>L

Hex Value: 1B 4C

The Partial Line Up <PLU> control character is to position the characters following it as superscripts until returned to the active line using the Partial Line Down <PLD> control character.

4.6.7 Next Line <NEL>

The <NEL> control character moves the active column position to column one of the following lines.

8-bit Control Code: <NEL>

Hex Value: 85

7-bit Escape Sequence: <ESC>E

Hex Value: 1B 45

The NEL command does not move the active position beyond the page boundary (bottom of form).

4.6.8 Single Shift 2 <SS2>

The <SS2> control character sets the printer to select the next printable character from the G2 character set.

8-bit Control Code: <SS2>

Hex Value: 8E

7-bit Escape Sequence: <ESC>N

Hex Value: 1B 4C

4.6.9 Single Shift 3 <SS3>

The <SS3> control character sets the printer to select the next printable character from the G3 character set.

8-bit Control Code: <SS3>

Hex Value: 8F

7-bit Escape Sequence: <ESC>O

Hex Value: 1B 4D

4.6.10 Device Control String Introducer <DCS>

The <DCS> control character introduces the Sixel Graphics Mode device control string.

8-bit Control Code: <DCS>

Hex Value: 90

7-bit Escape Sequence: <ESC>P

Hex Value: 1B 50

4.6.11 Control Sequence Introducer <CSI>

The <CSI> control character introduces an 8-bit control sequence.

8-bit Control Code: <CSI>

Hex Value: 9B

7-bit Escape Sequence: <ESC>[

Hex Value: 1B 5B

4.6.12 String Terminator <ST>

The <ST> control character terminates an 8-bit control string.

8-bit Control Code: <ST>

Hex Value: 9C

7-bit Escape Sequence: <ESC>\

Hex Value: 1B 5C

4.6.13 Operating System Command <OCS>, Privacy Message <PM>, and Application Program Command <APC>

The LG31 recognizes the start of these control strings, but will ignore all data following these sequences until terminated by the String Terminator <ST>.

Chapter 5

TEXT MODE ESCAPE AND CONTROL SEQUENCES

5.1 General

This chapter describes the escape sequences and control sequences used by the LG31 in text printing. The sequences are multi-byte control functions not provided by the single byte control codes.

5.2 Format

The LG31 uses escape and control sequences standardized by the American National Standards Institute (ANSI) to control many of its functions. Other LG31 functions have escape sequences defined within parameters of the ANSI standard. ANSI standards X3.4-1977 and X3.32-1973 define the escape and control sequences used in this chapter.

5.2.1 Escape Sequence Format

The general format of an escape sequence is:

<ESC>	I...I	F
1BH	20H - 2FH	30H - 7EH
Escape	Intermediate	Final
Sequence	Characters	Character
Introducer	(0 or more	(1 character)
	characters)	

The escape sequence introducer is the <ESC> control character (1BH). When the <ESC> is received, the next characters received within the proper range are not printed but are stored to be interpreted as part of the sequence.

If the characters following <ESC> are in the range of (20H - 2FH), they are "intermediate characters". The printer recognizes escape sequences with up to two intermediate characters. Therefore, only the first **two** intermediate characters are stored; subsequent intermediate characters are not stored. However, if more than two intermediate characters are received, the printer notes the event so that when the final character arrives, the entire escape is ignored.

If the character following the escape character or intermediate characters is in the range of (30H - 7EH), it is defined as a "final character". The final character indicates the end of the escape sequence. The intermediate and final characters together define the function of the sequence. If recognized, the printer will perform the action specified by the sequence, then continue to process received text characters in the normal fashion.

If characters following the <ESC> code are not within the defined ranges, the entire sequence is ignored. If the characters following the <ESC> code are within the defined ranges but are not recognized, the entire sequence is also ignored.

Example:

Action: Designate U.S. ASCII character set in G0

Sequence:

```

<ESC> (      B
1BH   28H   42H
|      |      |
|      |      |_____ Final Character, specifying ASCII
|      |_____ Intermediate Character
|_____ Escape Sequence Introducer

```

5.2.2 Control Sequence Format

The general format of a **<CSI>** sequence is:

(<CSI>)	P..P	I...I	F
9BH	30H - 3FH	20H - 2FH	40H - 7EH
Control	Parameter	Intermediate	Final Sequence
Characters	Characters	Character	Introducer
	(0 or more characters)	(0 or more characters)	(1 character)

The Control Sequence Introducer **<CSI>** has an 8-bit code of (9BH) which is equivalent to the 7-bit escape sequence of **<ESC>** (1BH) and “[” (5BH) characters. Both **<CSI>** and **<ESC>[** are recognized as the Control Sequence Introducer. After **<CSI>** or **<ESC>[** is received, all characters received within the proper range are not printed but stored to be used as part of the sequence.

Characters in the range of (30H - 39H), following **<CSI>**, are defined as “parameter characters”. A parameter character modifies the action or interpretation of the sequence. Generally, a parameter character is an ASCII representation of a decimal digit and signifies a numerical value to the sequence.

Parameters are interpreted as unsigned decimal integers, with the most significant digit sent first. Leading zeros are allowed but are ignored. A group of numeric parameters are separated by a semicolon “;” (3BH).

If a decimal value is not specified for a parameter character in a sequence, a value of zero is assumed for the parameter unless otherwise stated. The maximum value for a numeric parameter is 65535. Any larger value received is replaced by the maximum value allowed by that sequence, unless otherwise stated. There is a limit of 16 numeric parameters-per-string. If more than 16 numeric parameter values are received, only the first 16 are retained for evaluation.

If the printer receives the parameter characters (3AH), “:”, (3DH), “+”, or (3EH) “>” anywhere in the parameter string, the printer performs no action until the “final character” is received, and then ignores the entire sequence. The parameter character (3CH) “<” is used to begin and end VFU load (see section on “Forms Control”). The parameter character (3FH) “?” is used in some Device Status Request (DSR) commands (see section on “Device Status Request”).

If the printer receives a <CSI> sequence containing groups of parameters, and one or more group(s) is invalid, the printer does not ignore the entire sequence but processes those parameters which are recognized.

If all groups of parameters in a sequence are out of range or the sequence is recognized as invalid, the printer performs no action until the final character is received, and then ignores the entire sequence.

A character in the range of (20H - 2FH), received after the <CSI> code or after the parameter character(s), is defined as an "intermediate character". The printer processes sequences with up to one intermediate character. Therefore, only one intermediate character is stored. If more than one intermediate character is received, the printer notes the event so that when the "final character" is received, the entire control sequence is ignored.

A character in the range of (40H - 7EH), following <CSI> or after any number of parameter characters, is defined as a "final character". The final character indicates the end of the sequence. Any valid parameter characters together with the final character define the function of the sequence. If applicable, the printer performs the action specified by the sequence and then continues to process received characters in the normal fashion. If the sequence is not recognized as a function of the printer, it is be ignored.

Example:

Action: Set horizontal pitch to 12 characters-per-inch.
Sequence:

<ESC>	[	2	w	
1BH	5BH	32H	77H	
				Final Character
				Parameter Character
				Control Sequence Introducer

Equivalent Sequence (for 8-bits only):

<CSI>	2w	
9BH	32H	77H

Final Character
Parameter Character
Control Sequence Introducer

5.3 Error Recovery

This section describes the printers actions when invalid parameters and control functions are specified, and when control characters are embedded in control functions. Generally, the printer will recover from these conditions by performing as much of the function as possible.

1. Sequences not recognized by the printer are ignored.
2. Unless otherwise stated, control sequences with an invalid selective parameter are ignored.
3. Unless otherwise stated, when a numeric parameter exceeds the specified limit, the maximum allowable value for that parameter is used.
4. If a **C0** control character is received within a sequence, the control character is executed as if it were received before the sequence. Processing of the sequence will then resume.

The following are exceptions to this rule:

If the control character is **<CAN>** (18H) or **<SUB>** (1AH), the sequence is aborted and the control character is processed.

If the control character is **<ESC>** (1BH), the sequence is aborted and processing of a new sequence or text begins.

5. If a **C1** control character is received within an escape or control sequence, the sequence is aborted and the **C1** control character will be processed if it is recognized by the printer; otherwise it is ignored.
6. If character (**A0H**) is received within a control sequence, it is processed as a **<SP>** (20H) character and processing of the sequence will then continue.
7. If character (**FFH**) is received within a control sequence, it is processed as a **** (7FH) character and processing of the sequence will continue.
8. If a **GR** character is received during a control sequence, the eighth bit is ignored. The remaining seven bits are processed as a **GL** character.
9. **SS2** and **SS3** Processing:

If a **C0** or **C1** control character is received after a single shift control character (**<SS2>** (8EH) or **<SS3>** (8FH)), the control character is processed and the Single Shift Flag remains set.

If a Control Sequence is received after **SS2 (8EH)** or **SS3 (8FH)**, the sequence is processed and the Single Shift Flag remains set.

When **<SP> (20H)** or ** (7FH)** is received after (**SS2** or **SS3**), one of the following will occur:

- If a 94-character character set resides in the set being accessed (**G2** or **G3**), **<SP>** or **** will be processed and the Single Shift Flag remains set.
- If a 96-character character set resides in the set being accessed (**G2** or **G3**), the printer images the corresponding character (**A0H** or **FFH**) of that set and then resets the Single Shift Flag.
- If a **GR** character is received after **SS2** or **SS3**, the eighth bit is ignored. The Single Shift Function is applied to the remaining seven bits (defining a **GL** character).

The occurrence of a **GR** character after **SS2** or **SS3** is considered an error. Future models of the LG31 may not process this error in the same way. Therefore, software should never send a **GR** after **SS2** or **SS3**.

When (**A0H**) or (**FFH**) is received after (**SS2**) or (**SS3**), the following will occur:

- If a 94-character character set resides in the set being accessed (**G2** or **G3**), the printer will print the error character (Reverse Question Mark) and then reset the Single Shift Flag.
- If a 96-character character set resides in the set being accessed (**G2**) or (**G3**), the printer images the corresponding character (**A0H**) or (**FFH**) of that set and then resets the Single Shift Flag.

5.4 Text Mode Sequence Descriptions

The following sections describe the LG31 printer's Text Mode escape and control sequences.

5.4.1 Select Character Set (SCS)

The Select Character Set (SCS) escape sequences assign any one of the LG31 printer's character sets (see Appendix A) to the **G0**, **G1**, **G2**, or **G3** character set designators. These designators define the contents of the **GL** and **GR** printable sets and can be controlled with the single shift commands (see Chapter 4).

The character sets and the **SCS** sequences to select them are listed in Table 5-1.

5.4.2 Assigning Active Character Sets Using Single and Locking Shifts

In the 7-bit environment, only the **GL** active character set is available. Sequences referring to the **GR** active character set are ignored. In the 8-bit environment, the printer uses the **GL** active character set if the character's eighth bit is 0, and the **GR** active character set if the eighth bit is 1.

Table 5-2 lists and describes the escape sequences and control codes that assign available character sets to the **GL** and/or **GR** active character sets.

Table 5-1: Select Character Set Sequences

G0	G1	G2	G3	Character Set
<ESC>(B <ESC>(A	<ESC>(B <ESC>(A	<ESC>*B <ESC>*A	<ESC>+B <ESC>+A	U.S. ASCII Digital Great Britain
<ESC>(5 <ESC>(R	<ESC>(5 <ESC>(R	<ESC>*5 <ESC>*R	<ESC>+5 <ESC>+R	Digital Finnish ISO French (France)
<ESC>(9	<ESC>(9	<ESC>*9	<ESC>+9	Digital French Canadian
<ESC>(K <ESC>(Y <ESC>(J	<ESC>(K <ESC>(Y <ESC>(J	<ESC>*K <ESC>*Y <ESC>*J	<ESC>+K <ESC>+Y <ESC>+J	ISO German ISO Italian JIS Roman (Japan)
<ESC>(6	<ESC>(6	<ESC>*6	<ESC>+6	Digital Norwegian/Danish
<ESC>(Z <ESC>(7	<ESC>(Z <ESC>(7	<ESC>*Z <ESC>*7	<ESC>+Z <ESC>+7	ISO Spanish Digital Swedish
<ESC>(0	<ESC>(0	<ESC>*0	<ESC>+0	Digital VT100 Special Graphics
<ESC>(>	<ESC>(>	<ESC>* >	<ESC>+ >	Digital Technical Set
<ESC>(')	<ESC>(')	<ESC>* ')	<ESC>+ ')	ISO Norwegian/Danish
<ESC>(4 <ESC>(=	<ESC>(4 <ESC>(=	<ESC>*4 <ESC>*=	<ESC>+4 <ESC>+=	Digital Dutch Digital Swiss
<ESC>(%6 <ESC>(%5	<ESC>(%6 <ESC>(%5	<ESC>*%6 <ESC>*%5	<ESC>+%6 <ESC>+%5	Digital Portuguese Digital Supplemental

Any other character following <ESC>, <ESC>), <ESC> *, or <ESC>+ will cause the entire escape sequence to be ignored.

Table 5-2: Assigning Character Sets

Name	Mnemonic	Sequence	Function
Single Shift 2	SS2*	<ESC>N 1BH 4EH	The character following SS2 will be selected from the G2 character set.
Single shift 3	SS3*	<ESC>O 1BH 4FH	The character following SS3 will be selected from the G3 character set.
Locking Shift 0	LS0	<SI> OFH	The G0 character set becomes the active GL character set.
Locking Shift 1	LS1	<SO> OEH	The G1 character set becomes the active GL character set.
Locking Shift 2	LS2	<ESC>n 1BH 6EH	The G2 character set becomes the active GL character set.
Locking Shift 3	LS3	<ESC>o 1BH 6FH	The G3 character set becomes the active GL character set.
Locking Shift 1 Right	LS1R	<ESC>~ 1BH 7EH	The G1 character set becomes the active GR character set.
Locking Shift 2 Right	LS2R	<ESC> 1BH 7DH	The G2 character set becomes the active GR character set.
Locking Shift 3 Right	LS3R	<ESC> 1BH 7CH	The G3 character set becomes the active GR character set.

*SS2 and SS3 only affect the first printable GL character following the single shift sequence. The printer processes non-printable characters (space, sequences, control codes) as usual.

The effect of a locking shift (LS0, LS1, LS2, LS3, LS1R, LS2R, or LS3R) remains in effect until another locking shift is received.

5.4.3 Selecting Fonts and Font Attributes (SGR)

Selecting fonts and font attributes are part of the same family of control and escape sequences called Select Graphic Rendition (SGR). The sequences in this section allow you to select one of four fonts and/or one or more font attributes.

7-bit Escape Sequence: **<ESC>[Pn;...;Pnm**

Hex Value: **1B 5B Pn 3B ... 3B Pn 6D**

8-bit Control Sequence: **<CSI>Pn;...;Pnm**

Hex Value: **9B Pn 3B ... 3B Pn 6D**

Font and/or font attributes are selected using the (Pn) values listed below:

(Pn) Value	Font Selections
10	Data processing font (DP)
11	Near Letter Quality Font (NLQ)
12	OCR-A Font
13	OCR-B Font

(Pn) Value	Font Attribute Selections
0	Disables All Font Attributes.
1*	Enables Bold Printing (double strike).
3†	Enables Italic Printing.
4‡	Enables Underlining of Spaces and Characters.
22	Disables Bold Printing.
23	Disables Italic Printing.
24	Disables Underlining.

*Bold printing can be used with the Data Processing and NLQ Fonts at all available pitches and font attributes.

†Italicized printing can be enabled while in any font but the printing of the characters will occur in an NLQ font. Italics is not available for the 16.7 CPI.

‡Underlining can be used with all fonts and pitches.

Receipt of the Bold Print attribute sets the printer to double-strike until disabled. Individual characters on a line can be bolded if the sequence is introduced at the position for bolding to start, and then cancelled when unbolded (normal) text starts using the <ESC> [22m sequence.

Italicized Print: receipt of the Italics attribute sets the printer to Italicize characters until the command is terminated using the <ESC> [23m sequence.

Underlined Print: receipt of the Underline attribute sets the printer to underline characters and spaces until the command is terminated using the <ESC> [24m sequence.

5.4.4 Graphic Size Modification (GSM)/Character Expansion

Allows the expansion of the vertical (height) and horizontal (width) dimensions of printed characters.

7-bit Escape Sequence: <ESC>[Pn1;Pn2<SP>B

Hex Value: 1B 5B Pn1 3B Pn2 20 42

8-bit Control Sequence: <CSI>Pn1;Pn2<SP>B

Hex Value: 9B Pn1 3B Pn2 20 42

The Pn1 (vertical expansion) and Pn2 (horizontal expansion) values are defined as follows:

Vertical Expansion	Pn1 Value	Horizontal Expansion	Pn2 Value
1x*	100	1x*	100
2x	200	2x	200
3x	300		

*Normal height/width characters

The graphic size modification (GSM) control sequence is ignored in the OCR-A and OCR-B fonts.

If Pn1 and/or Pn2 are missing, the default expansion (1x) is implemented for the missing value. An invalid Pn value will cause the best fit expansion to be implemented.

When double-width characters are set, the columns will be double width with the horizontal tabs set to the double width columns. When the double-width expansion is disabled, the horizontal tab stops are reset to normal width columns. Spaces are also expanded when double-width characters are set.

If vertical expansion is selected, vertical pitch is expanded by the same expansion factor.

Examples: <ESC>[:200<SP>B sets 1x vertical (normal) and 2x horizontal expansion.
 <ESC>[200;200<SP>B sets 2x vertical and 2x horizontal expansion.
 <ESC>[300;<SP>B sets 3x vertical and 1x (normal) horizontal expansion.

5.4.5 Horizontal and Vertical Character Spacing

This section describes the escape and control sequences affecting the horizontal spacing or pitch between characters (characters-per-inch) and vertical spacing or pitch between lines (lines-per-inch).

5.4.5.1 Set Horizontal Pitch (DECSHORP)

Sets character width and spacing in units of characters-per-inch (CPI).

7-bit Escape Sequence: <ESC>[Pnw

Hex Value: 1B 5B Pn 77

8-bit Control Sequence: <CSI>Pnw

Hex Value: 9B Pn 77

The horizontal pitch selection values (Pn) are defined as follows:

Pn Value	Horizontal Pitch (CPI)*
0	10
1	10
2	12
3	13.3
4	16.7
5	5
7	6.67
8	8.35
9	15

*CPI = characters per inch

If the **Pn** value is missing, the horizontal pitch will default to **10 CPI**. An invalid **Pn** value will cause the default (**10 CPI**) pitch to be selected. Horizontal pitch is automatically set to **10 CPI** after a font selection is made.

The 5, 6.67, and 8.35 CPIs are created using horizontal expansions of the 10, 13.3, 15 and 16.5 CPIs.

Changing the horizontal pitch does not change the horizontal tab settings.

The following lists the horizontal pitches available in each font:

Current Font	Horizontal Pitch (CPI)		
	5, 6.67, 8.35	10	12, 13.3, 15, 16.7
Data Processing†	Yes	Yes	Yes
NLQ*	Yes	Yes	Yes
OCR-A	NLQ‡	Yes	NLQ
OCR-B	NLQ	Yes	NLQ

*NLQ = Near Letter Quality

†“Yes” indicates that the horizontal pitch is available in the current font.

‡“NLQ” indicates that the Near Letter Quality font is automatically substituted for the OCR-A and OCR-B fonts in all horizontal pitches, except the 10 CPI. If the horizontal pitch is changed to 10 CPI, the printer will return to the selected OCR font.

5.4.5.2 Vertical Pitch (DECVERP)

Sets spacing between lines in units of Lines-Per-Inch (LPI).

7-bit Escape Sequence: <ESC>[Pnz

Hex Value: 1B 5B Pn 7A

8-bit Control Sequence: <CSI>Pnz

Hex Value: 9B Pn 7A

If the Pn value is missing, the vertical pitch will default to 6 LPI. An invalid Pn value will cause the default (6 LPI) pitch to be selected.

The vertical pitch selection values (Pn) are listed as follows:

Pn Value	Vertical Pitch (LPI)
0	6 (see notes 1 and 3)
1	6 (see notes 1 and 3)
2	8 (see notes 1 and 3)
3	12 (see notes 1, 2, and 3)
4	2 (see notes 1 and 3)
5	3 (see notes 1 and 3)
6	4 (see notes 1 and 3)
7	10 (see notes 1, 2, and 3)

Note 1

Changing vertical pitch neither clears the vertical margins nor changes the forms length.

Note 2

Vertical pitches of 10 and 12 lines/inch are accomplished by reversing the paper. The resulting lines will overlap by a maximum of two dot rows.

Note 3

Changing vertical pitch will not change the row numbers at which the vertical tab stops are enabled. If at 6 LPI, line 15 had a vertical tab, changing to 8 or 10 LPI will not change the vertical tab set at row 15.

5.4.6 Print Area Parameters

This section describes the escape and control sequences defining the print area parameters. These parameters are defined by the line-per-physical-page, set top and bottom margins, and set left and right margins sequences.

5.4.6.1 Set Lines Per Physical Page (DECSLPP)

Sets the page length by selecting the number of lines (Pn) per page (form) at the current vertical pitch. The maximum form length is 22 in (55.9 cm).

7-bit Escape Sequence: **<ESC>[Pnt**

Hex Value: **1B 5B Pn 74**

8-bit Control Sequence: **<CSI>Pnt**

Hex Value: **9B Pn 74**

The table below shows the maximum number of lines (Pn) for a 22 in (55.9 cm) form:

Vertical Pitch (LPI)	Maximum Number of Lines (Pn)	Inches (cm) per Line
2	44	1/2 (1.27)
3	66	1/3 (0.85)
4	88	1/4 (0.64)
6	132	1/6 (0.42)
8	176	1/8 (0.32)
10	220	1/10 (0.25)
12	244	1/12 (0.21)

The active line becomes the Top Of Form (TOF) when the DECSLPP sequence is received. Therefore the operator must first align the paper to the desired TOF before the sequence is sent.

Note

The maximum forms length is determined by the vertical pitch setting of the printer.

5.4.6.2 Set Top and Bottom Margins (DECSTBM)

Sets the top margin (first printable line) and bottom margin (last printable line) parameters. Values (Pn1 and Pn2) are given in line numbers at the current vertical pitch (LPI).

7-bit Escape Sequence: <ESC>[Pn1;Pn2r

Hex Value: 1B 5B Pn1 3B Pn2 72

8-bit Control Code: <CSI>Pn1;Pn2r

Hex value: 9B Pn1 3B Pn2 72

See the table in Section 5.4.6.1 to calculate the maximum number of lines allowed for Pn1 (top margin) and Pn2 (bottom margin) values. Depending on the vertical pitch setting, Pn2 minus Pn1 cannot exceed the maximum number of lines allowed at that pitch.

Changing vertical pitch (LPI) changes the physical size of the form because the top and bottom margins are expressed in line units.

If the active line is above the new top margin, the active line is advanced to the new top margin.

If the active line is below the new bottom margin, a form feed is generated to advance the paper to the new top margin.

When the lines-per-page/form length (DECSLPP) is changed, the top and bottom margins are reset to default values (top margin is line 1 and bottom margin is the form length).

Pn Value	Action
If Pn1 > Pn2	The DECSTBM sequence is ignored.
If Pn1 is missing	The default value is line 1.
If Pn2 is missing	The default value is the form length.

5.4.6.3 Set Left and Right Margins (DECSLRM)

Sets the left margin (first printable column) and right margin (last printable column) parameters. Values (Pn1 and Pn2) are given in column numbers at the current horizontal pitch (CPI). Pn1 is the column number of the left margin and Pn2 is the column number of the right margin.

7-bit Escape Sequence: <ESC>[Pn1;Pn2s

Hex Value: 1B 5B Pn1 3B Pn2 73

8-bit Control Code: <CSI>Pn1;Pn2s

Hex Value: 9B Pn1 3B Pn2 73

The maximum allowable value of the Pn1 parameter is always one column less than the Pn2 parameter.

Pn Value	Action
If Pn1 = 0 or none	The left margin does not change.
If Pn2 = 0 or none	The right margin does not change.
If Pn1 > Pn2	The DECSLRM sequence is ignored.

If Pn2 is greater than the right-most printable position, the right margin is set to the right-most printable position.

If the active position is less than the left margin specified by this command, the active position is set to the new left margin.

If Autowrap is enabled, and the active position is past the right margin specified by this command, then the next printable character will generate a carriage Return/Line Feed before this character is printed.

If Autowrap is disabled (truncated), and the active position is past the right margin, printable characters that follow will be ignored until the cursor is brought within the printable area.

The margins set by this sequence are defined as hard margins because printing is not permitted outside them. The only exception to this rule is vector drawing. The vector sequence permits drawing outside the margins.

When character pitch is changed and the same physical margins are desired, it will be necessary to reset the margins using this escape sequence before any data is sent. Changing the horizontal pitch resets the left and right margins to their printable limits (column 1 and the right-most position respectively).

5.4.7 Active Column and Active Line Commands

This section describes the sequences and control codes affecting the active column and active line positioning.

5.4.7.1 Set Forward INDEX (IND)

Causes the active position to move to the same horizontal position on the next line.

7-bit Escape Sequence: **<ESC>D**

Hex Value: **1B 44**

8-bit Control Code: **<IND>**

Hex Value: **84**

The **<IND>** command can move the active position past the page boundary onto the next form.

5.4.7.2 Set Reverse Index (RI)

Moves the active horizontal position (column) to the same position on the previous line.

7-bit Escape Sequence: **<ESC>M**

Hex Value: **1B 4D**

8-bit Control Code: **<RI>**

Hex Value: **8D**

The **<RI>** command does not move the the active position beyond the page boundary (top of form).

5.4.7.3 Next Line <NEL>

Moves the active column position to column 1 of the following line.

7-bit Escape Sequence: **<ESC>E**

Hex Value: **1B 45**

8-bit Control Code: **<NEL>**

Hex Value: **85**

The **<NEL>** command can move the active position beyond the page boundary (bottom of form).

5.4.7.4 Horizontal Position Absolute (HPA)

Moves the active horizontal position to column **Pn** on the active line.

7-bit Escape Sequence: **<ESC>[Pn'**

Hex Value: **1B 5B Pn 60**

See the table below for the maximum number of columns (dependent on CPI setting) on a 13.2 in (33.53 cm) print line.

CPI	Max. Columns	CPI	Max. Columns	CPI	Max. Columns
5	66	6.67	88	8.35	110
10	132	12	158	13.3	176
15	198	16.7	220		

If the column value (**Pn**) exceeds the right margin of the active line, **HPA** is set at the last column of the active line.

If the **Pn** value is missing or 0, the default is column 1.

If an attempt is made to move the active position past the right margin, the active position stops at the right margin.

5.4.7.5 Set Horizontal Position Relative (HPR)

Moves the active horizontal position **Pn** columns to the right of the present position.

If column **Pn** exceeds the right margin of the active line, **HPR** is set at one column past the right margin of the active line.

7-bit Escape Sequence: **<ESC>[Pna**

Hex Value: **1B 5B Pn 61**

8-bit Control Sequence: **<CSI>Pna**

Hex Value: **9B Pn 61**

See the table in the previous escape sequence (**HPA**) for the maximum number of columns on a 13.2 in (33.53 cm) line.

If the **Pn** value is missing or 0, the default is one column to the right of the active horizontal position.

If an attempt is made to move the active position past the right margin, the active position stops at the right margin.

5.4.7.6 Set Horizontal Position Backward (HPB)

Moves the active horizontal position **Pn** columns to the left of the present position.

If column **Pn** exceeds the left margin of the active line, **HPB** is set at one column to the left of the active horizontal position.

7-bit Escape Sequence: **<ESC>[Pnj**

Hex Value: **1B 5B Pn 6A**

8-bit Control Sequence: **<CSI>Pnj**

Hex Value: **9B Pn 6A**

If the **Pn** value is missing or 0, the default is one column to the left of the active horizontal position.

If an attempt is made to move the active position past the right margin, the active position stops at the right margin.

5.4.7.7 Vertical Position Absolute (VPA)

Moves the active vertical position to line **Pn** of the current page, while maintaining the active horizontal position (column).

7-bit Escape Sequence: **<ESC>[Pnd**

Hex Value: **1B 5B Pn 64**

8-bit Control Sequence: **<CSI>Pnd**

Hex Value: **9B Pn 64**

If the **Pn** value is missing or 0, the default value of 1 is assumed. If an attempt is made to move the active position past the last printable line on the form, the active position stops on the last line. The **VPA** sequence does not move the active position beyond the page boundary (bottom of form).

5.4.7.8 Vertical Position Relative (VPR)

Moves the vertical position **Pn** lines down from the current active vertical position on the current page, while maintaining the horizontal position (column).

7-bit Escape Sequence: **<ESC>[Pne**

Hex Value: **1B 5B Pn 65**

8-bit Control Sequence: **<CSI>Pne**

Hex Value: **9B Pn 65**

If the **Pn** value is missing or **0**, the default value of **1** is assumed. If an attempt is made to move the active position past the last printable line on the form, the active position stops on the last line.

The **VPR** sequence does not move the active position beyond the page boundary (bottom of form).

5.4.7.9 Set Vertical Position Backward (VPB)

Moves the vertical position **Pn** lines up (reverse paper feed) from the active vertical position on the current page, while maintaining the horizontal position (column).

7-bit Escape Sequence: **<ESC>[Pnk**

Hex Value: **1B 5B Pn 6B**

8-bit Control Sequence: **<CSI>Pnk**

Hex Value: **9B Pn 6B**

If the **Pn** value is missing or **0**, the default value of **1** is assumed.

The **VPB** sequence does not move the active position beyond the page boundary (top of form).

5.4.7.10 Cursor Up (CUU)

Moves the vertical position P_n lines up (reverse paper feed) from the active vertical position on the current page, while maintaining the horizontal position (column). CUU has the same effect as VPB.

7-bit Escape Sequence: **<ESC>[P n A**

Hex Value: **1B 5B P n 41**

8-bit Control Sequence: **<CSI>P n A**

Hex Value: **9B P n 41**

If the P_n value is missing or 0, the default value of 1 is assumed.

The CUU sequence does not move the active position beyond the page boundary (top of form).

5.4.7.11 Partial Line Down (PLD)

The default value is line 1.

Moves the active column position to the corresponding column position approximately 3/72 inch down.

7-bit Escape Sequence: **<ESC>K**

Hex Value: **1B 4B**

8-bit Control Code: **<PLD>**

Hex Value: **8B**

The **PLD** command is used to position printable characters following it as subscript characters until returned to the active line using the Partial Line Up (**PLU**) command.

5.4.7.12 Partial Line Up (PLU)

Moves the active column position to the corresponding column position approximately 3/72 inch up.

7-bit Escape Sequence: **<ESC>L**

Hex Value: **1B 4C**

8-bit Control Code: **<PLU>**

Hex Value: **8C**

The **PLU** command is used to position the characters following it as superscript characters until returned to the active line using the Partial Line Down (**PLD**) command.

5.4.8 Horizontal and Vertical Tab Commands

This section describes the sequences and control codes affecting horizontal and vertical tab commands.

5.4.8.1 Horizontal Tab Stop (HTS)

Sets a horizontal tab stop at the active column.

7-bit Escape Sequence: **<ESC>H**

Hex Value: **1B 48**

8-bit Control Code: **<HTS>**

Hex Value: **88**

5.4.8.2 Set Horizontal Tab Stops (DECSHTS)

Sets a maximum of 16 horizontal tab stops (Pn) on a print line-per-sequence. Two or more sequences can be combined to set a maximum of 198 horizontal tab stops-per-line.

Tab stop values (Pn) are specified in columns.

7-bit Escape Sequence: **<ESC>[Pn1;...;Pn16u**

Hex Value: **1B 5B Pn1 3B ... 3B Pn2 75**

8-bit Control Sequence: **<CSI>Pn1;...;Pn16u**

Hex Value: **9B Pn1 3B ... 3B Pn16 75**

See the following table for the maximum number of columns (dependent on CPI setting) on a 13.2 in (33.53 cm) print line.

CPI	Max. Columns	CPI	Max. Columns	CPI	Max. Columns
5	66	6.67	88	8.35	110
10	132	12	158	13.3	176
15	198	16.7	220		

Tab stops numbering more then 16-per-sequence or 198-per-line will be ignored.

5.4.8.3 Vertical Tab Set (VTS)

Sets a vertical tab stop at the active line.

7-bit Escape Sequence: **<ESC>J**

Hex Value: **1B 4A**

8-bit Control Code: **<VTS>**

Hex Value: **8A**

5.4.8.4 Set Vertical Tab Stops (DECSVTS)

Sets a maximum of 16 vertical tab stops (Pn)-per-sequence. Two or more sequences can be combined to set a maximum of 255 vertical tab stops-per-page.

Tab stop values (Pn) are specified in lines.

7-bit Escape Sequence: **<ESC>[Pn1;...;Pn16v**

Hex Value: **1B 5B Pn1 3B ... 3B Pn2 76**

8-bit Control Sequence: **<CSI>Pn1;...;Pn16v**

Hex Value: **9B Pn1 3B ... 3B Pn16 76**

Tab stops numbering more than 16-per- sequence or 255-per-page will be ignored.

5.4.8.5 Tabulation Clear (TBC)

Clears one or more horizontal or vertical tab stops depending on the Pn value.

7-bit Escape Sequence: <ESC>[Png

Hex Value: 1B 5B Pn 67

8-bit Control Sequence: <CSI>Png

Hex Value: 9B Pn 67

A listing of horizontal and vertical tab clear Pn values is provided in the following table:

Pn Value	Description
0	Clears the horizontal tab stop at the active column.
1	Clears the vertical tab stop at the active line.
2	Clears horizontal tab stops (including default settings) for the active line only. Any subsequent horizontal tab control code (HT) sets the active horizontal position on the right margin of the active line.
3	Clears all horizontal tab stops (including default settings). Any subsequent horizontal tab control code (HT) sets the active horizontal position on the right margin of the active line. Horizontal tabs will remain cleared until set with sequences, control codes or the reset facility.
4	Clears all vertical tab stops.

5.4.9 Set/Reset Controls

This section describes the control and escape sequences affecting the autowrap, carriage return, and linefeed functions of the printer.

5.4.9.1 Autowrap Mode (DECAWM)

This mode defines the printer's response when the print position is beyond the right margin.

Autowrap Mode Enabled

When **DECAWM** is enabled and the active position is beyond the right margin, all following printable characters are printed on the next line beginning at the left margin.

7-bit Escape Sequence: **<ESC>[?7h**

Hex Value: **1B 5B 3F 37 68**

8-bit Control Sequence: **<CSI>?7h**

Hex Value: **9B 3F 37 68**

Autowrap Mode Disabled

When **DECAWM** mode is disabled, all printable characters received beyond the right margin are ignored until the cursor is brought into the print area.

7-bit Escape Sequence: **<ESC>[?7l**

Hex Value: **1B 5B 3F 37 6C**

8-bit Control Sequence: **<CSI>?7l**

Hex Value: **9B 3F 37 6C**

5.4.9.2 Carriage Return/New Line Mode (DECCRNLM)

This mode defines the printer's response to the **<CR>** control code.

Carriage Return/New Line Mode Enabled

When **DECCRNLM** is enabled, a **<CR>** character returns the active column to the left margin and advances the paper one line.

7-bit Escape Sequence: **<ESC>[?40h**

Hex Value: **1B 5B 3F 34 40 68**

8-bit Control Sequence: **<CSI>?40h**

Hex Value: **9B 3F 34 40 68**

Carriage Return/New Line Mode Disabled

When **DECCRNLM** is disabled, a **<CR>** character returns the active column to the left margin without advancing to a new line.

7-bit Escape Sequence: **<ESC>[?40l**

Hex Value: **1B 5B 3F 34 40 6C**

8-bit Control Sequence: **<CSI>?40l**

Hex Value: **9B 3F 34 40 6C**

5.4.9.3 Line Feed/New Line (LNM) Mode

This mode defines the printer's response to the **<LF>** control code.

Line Feed/New Line Mode Enabled

When **LNM** is enabled, a **<LF>** character advances the paper one line and returns the active column to the left margin.

7-bit Escape Sequence: **<ESC>[20h**

Hex Value: **1B 5B 32 30 68**

8-bit Control Sequence: **<CSI>20h**

Hex Value: **9B 32 30 68**

Line Feed/New Line Mode Disabled

When **LNM** is disabled, a **<LF>** character advances the paper one line. The active column does not change.

7-bit Escape Sequence: **<ESC>[20l**

Hex Value: **1B 5B 32 30 6C**

8-bit Control Sequence: **<CSI>20l**

Hex Value: **9B 32 30 6C**

5.4.10 Vertical Forms Unit (VFU)

The escape and control sequences described in this section control loading and access of the VFU.

Vertical forms control is accomplished by loading the VFU table. The VFU table contains 12 channels; channels 1 and 12 are designated as top of form and bottom of form respectively; and the other 10 channels are defined as individual vertical page formats. Any one of the 12 channels can be called to implement that format.

There are three VFU sequences described in this section; one to load the 12 channel VFU table, one to end loading of the VFU table, and one to access the VFU table. Also included are descriptions of how to create/load and use the VFU table.

5.4.10.1 Load Vertical Format Unit (VFU)

The Load VFU sequence prepares the printer for the loading of the 12 channel VFU table. The data following the Load VFU sequence is loaded into the VFU memory as the VFU table (see Section 5.4.10.4 for examples). The Load sequence, followed by the VFU table data must be terminated immediately by the End VFU Load sequence.

7-bit Escape Sequence: <ESC>[<1h

Hex Value: 1B 5B 3C 31 68

8-bit Control Sequence: <CSI><1h

Hex Value: 9B 3C 31 68

VFU also defines the top of form. The position of the paper when the load VFU is sent determines the TOF. Align the paper at the desired top of form before you send the VFU.

5.4.10.2 End VFU Load

Immediately after the VFU table has been loaded with the desired data, the End VFU Load sequence must be sent to notify the printer that VFU table loading is complete (see Section 5.4.10.4).

7-bit Escape Sequence: <ESC>[<1l

Hex Value: 1B 5B 3C 31 6C

8-bit Control Sequence: <CSI><1l

Hex Value: 9B 3C 31 6C

5.4.10.3 VFU Channel Command

The VFU Channel Command sequence allows access to the VFU table previously loaded into the VFU memory. The nnn value (see the following table for examples) defines the channel to be used and direction of vertical movement.

7-bit Escape Sequence: <ESC>[nnn&y

Hex Value: 1B 5B n n n 26 79

8-bit Control Sequence: <CSI>nnn&y

Hex Value: 9B n n n 26 79

The VFU Channel Command sequence can retrieve any 1 of the 12 VFU channels and specify forward or reverse paper movement each time it is received. Channel and paper control are defined by the nnn values in the following table:

nnn*	Move Forward To Channel	nnn*	Move Backward To Channel
000	1	900	1
001	2	901	2
002	3	902	3
003	4	903	4
004	5	904	5
005	6	905	6
006	7	906	7
007	8	907	8
008	9	908	9
009	10	909	10
010	11	910	11
011	12	911	12

*Selecting a channel other than those listed above, or a channel that has not been defined (no vertical tab stops), will result in a default to channel 12 (BOF).

The VFU channel command can be sent to call the same channel each time data is to be printed. This means the paper is advanced to each successive tab stop when the command is received.

5.4.10.4 How to Create and Load the VFU Table

The data following the Load VFU sequence is made up of 12 channels of forms control data in VFU load format. Channels 1 and 12 are reserved for top of form and bottom of form formats. Channels 2-11 are reserved for vertical page formats.

If an error occurs during loading of the VFU table, the load is cancelled and the printer defaults to the forms established by the DECSLPP sequence or the control panel settings.

The VFU load format consists of two bytes (one byte pair) for each line of the VFU table. The maximum form length is 22 in (55.9 cm); the maximum number of lines (byte pairs) is given in Section 5.4.6.1. The byte pairs contain the data for each line of the vertical format as described below:

	Bit	8	7	6	5	4	3	2	1
Byte No. 1	Value	x	1	C6	C5	C4	C3	C2	C1
Byte No.2	Value	x	1	C12	C11	C10	C9	C8	C7

Bits 1-6: represent channels 1-12 (C1-C6 and C7-C12) with binary 1's or 0's. If a binary 1 is present, a vertical tab stop is activated for that channel at that line, a binary 0 indicates the absence of a vertical tab stop for that channel at that line.

Bit 7: must be a binary 1

Bit 8: can be a binary 0 or 1 (x), the value does not matter.

C1: channel 1 is the top of form (TOF) channel.

C2-C11: channels 2 through 11 are the vertical form channels.

C12: channel 12 is the bottom of form (BOF) channel.

The lower bits (1 through 6) of each byte pair contain the the information designating the absence or presence of a vertical tab stop for that line in each of 12 channels. The table below shows the VFU table loaded with 7-line (7-byte pairs) vertical formats. Remember, load the VFU table with the number of byte pairs equal to the number of lines in the form.

Bit No.	Byte No. 1								Byte No. 2							
	1	2	3	4	5	6	7	8	1	2	3	4	5	6	7	8
Channel No.	1	2	3	4	5	6	-	-	7	8	9	10	11	12	-	-
Line No. 1	1	0	0	0	0	0	1	x	0	0	0	0	0	0	1	x
Line No. 2	0	0	1	0	0	0	1	x	0	0	0	0	0	0	1	x
Line No. 3	0	1	0	0	0	0	1	x	0	0	0	0	0	0	1	x
Line No. 4	0	0	1	0	0	0	1	x	0	0	0	0	0	0	1	x
Line No. 5	0	1	0	0	0	0	1	x	0	0	0	0	0	0	1	x
Line No. 6	0	0	1	0	0	0	1	x	0	0	0	0	0	0	1	x
Line No. 7	0	0	0	0	0	0	1	x	0	0	0	0	0	1	1	x

The sample VFU table above shows the table loaded with two vertical page formats (channels 2 and 3), seven lines long. Channels 1 and 12 are designated as top and bottom of form formats.

Channel 1—Channel 1 specifies top of form (TOF). The first byte pair (line 1) loaded channel 1 with a 1, all other lines in channel 1 should be loaded with zeros (0's). When channel 1 is called, the paper will advance (or reverse) to the next (or current) TOF.

Channel 2—Channel 2 has vertical tab stops at lines 3 and 5.

Channel 3—Channel 3 has vertical tab stops at lines 2, 4, and 6.

Channels 4 through 11—These channels are undefined (loaded with 0's) in that no vertical tab stops (top and bottom of form included) have been specified.

Channel 12—Channel 12 specifies bottom of form (BOF). The last byte pair (last line) should load channel 12 with a 1, all other lines in channel 12 should be loaded with zeroes (0's). When channel 12 is called, the paper will advance (or reverse) to the next (or current) BOF.

The format used to load the data in the previous Table requires that the individual bytes be designated with the character equivalent of the binary value. After making up the VFU table as in the previous example, refer to Table D-1 in Appendix D for a cross reference of binary values (bit patterns) and the equivalent character. For example:

	Bit Pattern								Equivalent
	1	2	3	4	5	6	7	8	Character
Line 1, Byte 1	1	0	0	0	0	0	1	x	A
Line 1, Byte 2	0	0	0	0	0	0	1	x	@
Line 2, Byte 1	0	0	1	0	0	0	1	x	D
Line 2, Byte 2	0	0	0	0	0	0	1	x	@
Line 3, Byte 1	0	1	0	0	0	0	1	x	B
Line 3, Byte 2	0	0	0	0	0	0	1	x	@
Line 4, Byte 1	0	0	1	0	0	0	1	x	D
Line 4, Byte 2	0	0	0	0	0	0	1	x	@
Line 5, Byte 1	0	0	0	0	0	0	1	x	B
Line 5, Byte 2	0	1	0	0	0	0	1	x	@
Line 6, Byte 1	0	0	1	0	0	0	1	x	D
Line 6, Byte 2	0	0	0	0	0	0	1	x	@
Line 7, Byte 1	0	0	0	0	0	0	1	x	@
Line 7, Byte 2	0	0	0	0	0	0	1	x	@

When the individual bytes have been assigned equivalent characters, the VFU table can be loaded. The Load VFU control sequence <ESC> [<1h and the byte pair characters can be combined to load the VFU table. Remember to terminate the VFU table characters (equivalent byte pairs) with the End VFU Load control sequence <ESC>[11 as follows:

```

LOAD | VFU TABLE | END |
| | | |
<ESC> [<1hA@D@B@B@D@@@<ESC> [<11

```


Chapter 6

PRINTER ID, STATUS, AND RESET SEQUENCES

6.1 General

This chapter contains information for use by experienced programmers to facilitate the implementation of implement device attributes (Product ID), device status, and reset control sequences.

6.2 Printer ID Sequences

The host sends a request sequence to the printer for identification (ID). The printer then responds with a reply sequence (printer ID) to the host.

6.2.1 Send Device Attributes (DA)

Either of the control sequences below (two 7-bit and 8-bit) request the printer to send the host the product ID sequence.

7-bit Control Code: `<ESC>[c` or `<ESC>[0c`

Hex Value: `1B 5B 63` or `<ESC>1B 5B 30 63`

8-bit Control Code: `<CSI>c` or `<CSI>0c`

Hex Value: `2B 63` or `9B 30 63`

On receipt of either of the escape sequences above, the printer will respond by sending the host the product identification (ID) sequence. Depending on the setting of printer control strap 23, the printer will respond with one of the following sequences:

Printer Control Strap Setting	Product ID Sequence	Identified Product
17 set at "0" Hex value	<ESC>[742c 1B 5B 3F 34 32 63	LG31 Printer
17 set at "1" Hex value	<ESC>[736c 1B 5B 3F 33 36 63	LG01 Printer

6.3 Device Status Request and Report Sequences (DSR)

The control sequences described in this section control the printer's reporting of its device identification (ID).

6.3.1 Device Status Request (DSR)

The device status request sequence is sent to the printer requesting solicited or unsolicited status reports in either brief or extended format.

7-bit Control Code: **<ESC>[Pnn**

7-bit Hex Value: **1B 5B Pn 6E**

8-bit Control Code: **<CSI>Pnn**

8-bit Hex Value: **9B Pn 6E**

By default, unsolicited status reports are disabled. The status report requests are selected by Pn values shown in the following table:

Pn Value	Printer Status Request
0	Send an extended, solicited status report immediately.
1	Disable all unsolicited status reports.
2	Enable brief, unsolicited status reports and send an extended report immediately.
3	Enable extended, unsolicited status reports and send an extended status report immediately.

The printer will send a device status report to the host:

1. Immediately, if a solicited status report is requested, regardless of the error status.
2. If unsolicited status reports are enabled, and a reportable status condition has occurred.

6.3.2 Device Status Report (DSR)

The printer responds to the Device Status Request with a Device Status Report sent to the host. The reports are brief or extended reports, solicited or unsolicited. Solicited status reports are sent immediately to the host. Unsolicited status reports (if enabled) are sent when a reportable error occurs.

7-bit Control Code: **<ESC>[Pnn**

7-bit Hex Value: **1B 5B Pn 6E**

8-bit Control Code: **<CSI>Pnn**

8-bit Hex Value: **9B Pn 6E**

Default: none

The Device Status Reports (brief or extended format) the printer transmits to the host are defined as follows:

Brief Status Report

Report	Sequence
No Error Condition Exists:	<ESC>[0n 1B 5B 30 6E
An Error Condition Exists:	<ESC>[3n 1B 5B 33 6E

Extended Status Report

Report	Control Sequences
No Error Condition Exists:	<ESC>[0n 1B 5B 30 6E followed by: <ESC>[?20n 1B 5B 3F 32 30 6E
An Error Condition Exists:	<ESC>[3n 1B 5B 33 6E

followed by:

**<ESC>[Pn1;Pn2;...;n
1B 5B 3F Pn1 3B Pn2 3B ... 3B 6E**

Where Pn1;Pn2 ... are one or more error codes defined as follows:

Values	Description of Error
21	Hardware Failure - The reportable hardware failures are all errors listed in the Self-test Error Messages and the Font Checksum Error Messages.
22*	Communication Failure - A communications failure may be caused by a parity error, framing error, or receipt of an erroneous character.
23*	Input Buffer Overflow Error.
24	Printer Deselected (Off-Line).
26	Cover Open Error.
27	Paper Out Error.
28	Ribbon Out Error.
47	Too Many Errors (More Than 29 Errors).

- * Failures (communications and buffer overflow errors) defined as events can only be reset if an extended device status report is sent to the host. If the printer is set for solicited reports, the events can only be reset if the extended report is requested and sent to the host. If the printer is set for unsolicited reports, the extended report is immediately sent to the host and reset. The DECSTR and RIS resets clear any event which has not been reported.

Example: **<ESC>[3n<ESC>[?21;22n** is an Extended Status Report indicating a hardware and communications error condition.

6.4 Printer Reset Control Sequences

The sequences described in this section reset the printer features to the initial state.

6.4.1 Reset to Initial State (RIS)

Resets printer to default parameters without running the power-up self test. Data in the buffer is saved, and paper advances to the next top of form. See Appendix C for the power-up settings of parameters.

7-bit Control Code: **<ESC>c**

7-bit Hex Value: **1B 63**

8-bit Control Code: **None**

8-bit Hex Value: **None**

Upon receiving a reset sequence from the host computer or from the operators control panel, the LG31 defaults to the following conditions.

Table 6-1: LG31 Initial Conditions

Parameter	Parameter Initial State (Default)
Print Status	On-line (ready)
Horizontal Pitch	10 characters per 2.54 cm/in
Vertical Pitch	6 lines per inch
Font	Data Processing
Forms Length	66 lines (11 inches/27.94 cm)
Active Position	Column 1 on the following line
Top Margin	Line 1
Bottom Margin	Line 66
Left Margin	Column 1
Right Margin	Column 132
Underlining	Disabled
Bolding	Disabled
Italics	Disabled
Character Expansion	No character expansion
GL Character Set	U.S. ASCII or the last NCR if selected
GR Character Set	Digital Supplemental
G0 Character Set	U.S. ASCII or the last NCR if selected
G1 Character Set	VT100 Graphic Character Set
G2 Character Set	Digital Supplemental
G3 Character Set	U.S. ASCII

Table 6–1 (Cont.): LG31 Initial Conditions

Parameter	Parameter Initial State (Default)
Autowrap	Enabled
Line Feed/New Line Mode	Reset
Horizontal tabs	At every 8 columns (9, 17,...137)
Unsolicited reports	Disabled
Super/Subscripts	Disabled
Carriage Return New Line Mode	Reset
Vertical Tabs	Every line (1, 2, ... 66)

The following will not change:

- All Interface Settings
- The National Replacement Character Set

These parameters will remain as previously selected (either through escape sequences or through the control panel).

6.4.2 Soft Terminal Reset (DECSTR)

Same as the Reset to Initial State (RIS) sequence, (**<ESC>[!p**). See Table 6–1 for the initial state of the parameters reset by **<ESC>[!p**.

7-bit Control Code: **<ESC>[!p**

7-bit Hex Value: **1B 5B 21 70**

8-bit Control Code: **<CSI>!p**

8-bit Hex value: **9B 21 70**

Chapter 7

SIXEL GRAPHICS

7.1 General

Sixel graphics are selected using the appropriate control sequence and cannot be selected by the operator at the operator control panels.

The Sixel Protocol is a bit-image rasterized method of transmitting and displaying graphic images. The LG31 is capable of receiving and printing Sixel files sent from the host. Although the Sixel protocol allows encoding of color information, printing will be in monochrome only.

A Sixel is a group of six vertical picture elements (SIX pixELs) that represents a section of a graphic image and can be sent in one byte (7 or 8 bits). The printer processes a Sixel byte such that a bit value of 1 signifies the presence of a pixel, and a bit value of 0 signifies no pixel.

The Sixel protocol incorporates a method for defining the horizontal and vertical grid sizes as well as the image aspect ratio.

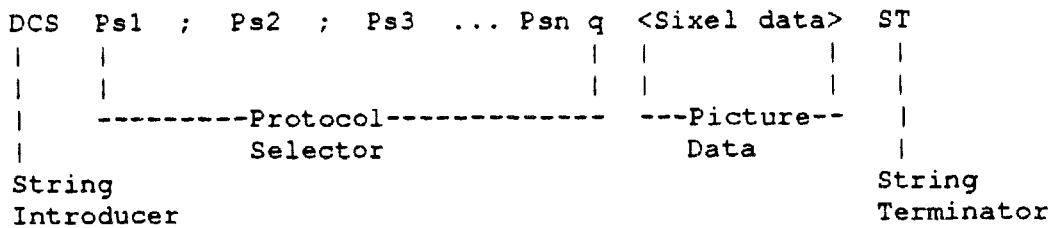
7.2 Sixel Protocol

Sixel Protocol is contained within an ANSI-defined Device Control String **<DCS>** envelope. This envelope is initiated by the string introducer **<DCS>** control code and terminated by the String Terminator **<ST>** control code. The following components make up the complete Device Control String for the Sixel Protocol.

Sixel Protocol - Device Control String:

1. String Introducer.
2. Protocol Selector.
3. Picture Data.
4. String Terminator.

This control string is assembled as follows:



7.3 String Introducer

The string introducer **<DCS>** control code (**90H** in 8-bit mode) or **<ESC>P** (**1BH**, **50H** in 7-bit mode) will identify the start of the Sixel Protocol.

7.4 Protocol Selector

The Protocol Selector may consist of a string of zero, one, or more numeric parameters each separated by the parameter separator character “;” (3BH). A valid numeric parameter consists of zero, one, or more digits in the range of 0 - 9 (30H - 39H). Any numeric parameter in combination with the valid final character “q” (71H), causes the printer to enter Sixel Graphics Mode.

The Protocol Selector has the following format:

Ps1	;	Ps2	;	Ps3	...	Ps?	q
****	3BH	***	3BH	***	...	***	71H

7.4.1 Macro Parameter (Ps1)

This is a selective parameter of fixed Horizontal Grid Size and Aspect Ratio combinations which are most often used. This parameter provides for backward compatibility with existing software and should not be used by new software.

Note

It is recommended that new software sets Ps1 to zero and explicitly defines the Horizontal Grid Size using Ps3 and the aspect ratio numerator and denominator using Ps1 and Ps2 of the Sixel data control sequence “Set Raster Attributes”.

Ps1 Macro Value*	Horizontal Grid Size (Inches)	Aspect Ratio (Vert:Horz)
0 or None	1/140" (0.0071)	200:100
1	1/140" (0.0071)	200:100
2, default to:	1/180" (0.0056)	250:100
3, default to:	1/180" (0.0056)	250:100
4	1/180" (0.0056)	250:100
5, default to:	1/140" (0.0071)	200:100
6, default to:	1/90" (0.0111)	125:100
7, default to:	1/90" (0.0111)	125:100
8, default to:	1/90" (0.0111)	125:100
9	1/70" (0.0143)	100:100

* Macro Values 2,3,5,6,7 and 8 are default definitions required by this printer.

- If Ps1 is greater than 9, the printer defaults to Ps1 = 0.
 - ; = Parameter Separator, marking the end of the current parameter.
-

7.4.2 Background Select (Ps2)

Ps2 is not used by this printer and will be ignored.

7.4.3 Horizontal Grid Size (Ps3)

Ps3 defines the horizontal grid size in decipoints (1/720 inch) and in conjunction with the aspect ratio defines the grid size.

This printer performs default horizontal grid sizes for some decipoint values. This table identifies the horizontal grid size used for each Ps3 value.

Ps3 Decipoints (1/720")	Horizontal Grid Size (Inches)
0 or None*	No change to HGS (defined by Ps1)
1, 2, and 3 default to:	1/180" (0.0056")
4	1/180" (0.0056")
5	1/140" (0.0071")
6 defaults to :	1/140" (0.0071")
7 defaults to:	1/140" (0.0071")
8	1/90" (0.0111")
9 defaults to:	1/90" (0.0111")
10	1/70" (0.0143")
11 - 19 defaults to:	1/70" (0.0143")
20	1/35" (0.0286")
21, 22, ... default to :	1/35" (0.0286")

* If Ps3 is zero or not present, the horizontal grid size is determined by the Macro Parameter (Ps1). Otherwise, Ps3 will override the Horizontal Grid Size portion of the Macro Parameter while attempting to preserve the Aspect Ratio.

When the 250:100 Aspect Ratio is selected by Ps1, and the Ps3 parameter selects:

Ps3 Selection	Resulting Aspect Ratio (AR) and Horizontal Grid Size (HGS)
1/180"	Maintain 250:100 AR and HGS = 1/180"
1/140"	Maintain 250:100 AR and change to HGS = 1/180"
1/90"	Maintain 250:100 AR and HGS = 1/90"†
1/70"	Maintain 250:100 AR and change to HGS = 1/90"†
1/35"	Maintain 250:100 AR and change to HGS = 1/90"†

*Resultant image is full scale.

†Resultant image is twice full scale.

When the 200:100 Aspect Ratio is selected by Ps1, and the Ps3 parameter selects:

Ps3 Selection	Resulting Aspect Ratio (AR) and Horizontal Grid Size (HGS)
1/180"	Change to 250:100 AR and maintain HGS = 1/180"
1/140"	Maintain 200:100 AR and HGS = 1/140"
1/90"	Maintain 200:100 AR and change to HGS = 1/140"
1/70"	Maintain 200:100 AR and HGS = 1/70"†
1/35"	Maintain 200:100 AR and change to HGS = 1/70"‡

*Resultant image is full scale.

†Resultant image is twice full scale.

When the 125:100 Aspect Ratio is selected by Ps1, and the Ps3 parameter selects:

Ps3 Selection	Resulting Aspect Ratio (AR) and Horizontal Grid Size (HGS)
1/180"	Maintain 125:100 AR and HGS = 1/180"
1/140"	Maintain 125:100 AR and change to HGS = 1/180"
1/90"	Maintain 125:100 AR and HGS = 1/90"†
1/70"	Maintain 125:100 AR and change to HGS = 1/90"†
1/35"	Change to 100:100 AR and maintain HGS = 1/35"‡

*Resultant image is half full scale.

†Resultant image is full scale.

‡Resultant image is twice full scale

When the 100:100 Aspect Ratio is selected by Ps1, and the Ps3 parameter selects:

Ps3 Selection	Resulting Aspect Ratio (AR) and Horizontal Grid Size (HGS)
1/180"	Change to 125:100 AR and maintain HGS = 1/180"
1/140"	Maintain 100:100 AR and HGS = 1/140"
1/90"	Maintain 100:100 AR and change to HGS = 1/140"
1/70"	Maintain 100:100 AR and HGS = 1/70"†
1/35"	Maintain 100:100 AR and HGS = 1/35"‡

*Resultant image is half full scale.
†Resultant image is full scale.
‡Resultant image is twice full scale.

7.4.4 Additional Parameters (Ps?)

All other parameters are reserved for future use and, if received, will be ignored without terminating this sequence.

7.4.5 Final Character (q)

Identifies this sequence as the Sixel Protocol Selector and places the printer in Sixel Mode.

If one or more of the following C0 control characters are detected within the Protocol Selector, this printer processes them as follows:

Control Characters	Action
<SUB>	Terminates the Protocol Selector sequence and enters Text Mode, then processes <SUB>.
<CAN>	Terminates the Protocol Selector sequence and enters Text Mode, then processes <CAN>.
<ESC>	Terminates the Protocol Selector sequence and enters Text Mode, then processes <ESC>.

All other C0 control codes, if received within the Protocol Selector, will be honored without terminating the sequence.

All C1 control codes, if received within the Protocol Selector, will terminate the Protocol Selector sequence processing and cause the printer to exit from Sixel character processing. C1 control codes applicable to this printer will then be processed.

7.5 Picture Data

Picture Data includes Sixel Printable Characters and Sixel Control Characters. All Picture Data is processed while in Sixel Graphics Mode. In this mode, instead of standard ASCII text mode processing, characters are processed as defined in this section.

7.5.1 Sixel Printable Characters

While in Sixel Graphics Mode, GL characters in the range **3FH - 7EH** are decoded as printable characters. Each of these 64 values represent an encoding of six vertical pixels to be printed. The actual pixel size is defined by the Horizontal Grid Size Parameter and the Pixel Aspect Ratio.

An offset of **3FH** is subtracted from each graphics printable character received, thus producing a binary value in the range **00H - 3FH**. The 6-bit binary value obtained represents a six pixel column definition. For each bit set to one, a corresponding print element (or group of elements in 2x Scale) are activated to form a dot. The least significant bit (bit 0) is associated with the top print element or group of elements.

Hex Code	ASCII Symbol	Binary Value	Pixels Activated	Action Performed
3F	?	000000	None	Advance by a Sixel Space.
40	@	000001	Top	Print top pixel only.
5F	-	100000	Bottom	Print bottom pixel only.
7E	~	111111	All	Print one full column.

If **C0** control codes are received as part of the picture data, the following action will be taken:

Control Characters	Action
<BEL>	Same action as in text mode
<SUB>	Process as if a ? <3FH> code (blank sixel) was received
<CAN>	DCS mode processing and Sixel graphics Mode are exited and text mode entered.

Control Characters	Action
<ESC>	DCS mode processing and Sixel graphics Mode are exited and text mode entered, and the escape sequence processed.

All other C0 control codes received as part of the picture data are ignored.

All GL codes in the range 20H - 7FH received as part of the picture data are treated as follows:

<SP>	Ignored
! (21H) to > (3EH)	Sixel commands
? (3FH) to ~ (7EH)	Sixel data
	Ignored

GR characters in the range of A0H - FFH are processed as GL characters by setting the eighth bit to zero.

If an attempt is made to print past the right-most position, the printer truncates all remaining Sixel data until the next Graphics Carriage Return [\$] or Graphics New Line [-].

7.5.2 Sixel Control Characters

Sixel Control Characters are GL characters in the range of SP - > (20H - 3EH). Note that this range also includes the parameter separator ; (3BH) and parameter digits 0 - 9 (30H - 39H).

GR characters in the range of (A0H - BEH) are processed as GL characters (the eighth bit is set to zero).

Those control characters assigned are processed as follows:

Hex Code	ASCII Symbol	Action Performed
21	!	Repeat Introducer
22	"	Set Raster Attributes
23	#	Color Introducer
24	\$	Graphic Carriage Return
2D	-	Graphic New Line
30 to 39	0 to 9	Numeric Parameters
3B	;	Parameter Separator

A sequence in Sixel Graphics Mode begins with a Sixel control character (not including **30H** - **39H** and **3BH**) and ends with either a printable character or another Sixel control character. For example, if a Graphic New Line (GNL) is received within a Repeat Sequence, the Repeat Sequence is ignored and the Graphic New Line (GNL) is processed. Therefore, if the following data is received

! - 200 ~

the printer will ignore the Repeat control character, process the **GNL**, ignore 200 since it is meaningless by itself and print ~ only once.

Control characters not assigned are ignored along with any parameters or parameter separators until the next valid control character or **ST** is received.

7.5.3 Repeat Introducer [!] and Sequence

A repeat sequence is defined as:

```
!      Pn      <printable character>
21H    ****
```

The numeric parameter specifies the number of times to print the character that follows. The numeric parameter is a string of characters in the range of **30H** - **39H** which is evaluated as a decimal number. If a numeric parameter is not received a value of one is assumed. If the parameter evaluates to zero, a value of one is assumed. If the parameter evaluates to a value greater than 65535, a value of 65535 is assumed. All decimal digits are processed as part of the count.

The printable character (a character in the range of **3FH - 7EH**) will be printed as many times as specified by the numeric parameter count. A repeat sequence has the same effect as receiving the printable character that number of times. All printable characters end the repeat sequence processing and cause printing to start.

Repeat Sequence Examples:

!	1	0	?	Repeat 10 graphic spaces.
21H	31H	30H	3FH	

!	6	@	Repeat 6 patterns of top dot.
21H	36H	40H	

7.5.4 Set Raster Attributes

To be valid, the Set Raster Attributes sequence must be received before the first Sixel Printable Character is received after entering Sixel Graphics Mode. This command must precede any Sixel or Sixel-positioning command within a single Sixel control string or the command will be ignored. The Set Raster Attributes sequence affects all Sixel data that follows.

If a Set Raster Attributes sequence is received after a Sixel Printable Character is received, the printer will still recognize this sequence but will disregard all parameters and will continue processing all following Sixel data and control codes as if this sequence was never received.

If a Set Raster Attributes sequence is received before any other Sixel Control Code, the Set Raster Attribute sequence will be processed.

If Set Raster Attributes sequence is received after another Sixel Control Code, the following will occur:

- If the Sixel Control Code is either in the range (**21H - 24H** or **2DH**), the printer will process this control code and recognize but ignore all Set Raster Attributes sequences that may follow.
- If the Sixel Control Code is one of the following, yet unspecified Digital control codes, **20H**, **25H - 2CH**, **2EH**, **2FH**, **30H - 3EH**, the printer will process the following Set Raster Attribute sequence. This allows for specifying a future control code to be the first received.

The Set Raster Attributes sequence format is as follows:

" Pn1 ; Pn2 ; Pn3 ; Pn4
22H *** 3BH *** 3BH *** 3BH ***

where:

" = Set Raster Attributes control character

Pn1 = Pixel Aspect Ratio Numerator

Pn2 = Pixel Aspect Ratio Denominator

Pn1 and Pn2 are numeric parameters. A numeric parameter is a string of characters in the range of **30H - 39H** which is evaluated as a decimal number. If the parameter evaluates to a value greater than 65535, the value 65535 will be assumed.

Pn3, Pn4, and all other parameters that are received before the next Sixel Control Code or Sixel Printable Character is received, are ignored by the LG31.

The Pixel Aspect Ratio defines the shape of the pixel needed to reproduce the picture without distortion. This ratio is defined by two numbers, a numerator and a denominator, and is the ratio of the vertical to the horizontal shape of the pixel.

For example, an aspect ratio of 2:1 or 200:100 represents a pixel twice as high as it is wide. The Aspect Ratio (AR) multiplied by the Horizontal Grid Size (HGS) yields the ideal Vertical Grid Size (VGS).

The LG31 supports the following aspect ratios:

Aspect Ratio	Sixel Scale	HGS (inch)	Horizontal Dots/Pixel	VGS (inch)	Vertical Dots/Pixel
250:100	Full	1/180	1	1/72	1
	2x	1/90	2	1/36	2
200:100	Full	1/140	1	1/72	1
	2x	1/70	2	1/36	2
125:100	0.5x	1/180	1	1/144	1/2
	Full	1/90	2	1/72	1
100:100	0.5x	1/140	1	1/144	1/2
	Full	1/70	1	1/72	1
	2x	1/35	2	1/36	2

Other aspect ratios, if requested, will be processed by the printer as follows:

- If the AR is less than 150:100, the printer uses 100:100 AR.
- If the AR is less than 110:100, the printer uses 100:100 AR.
- If the AR is greater than or equal to 160:100 and less than 225:100, the printer uses 200:100 AR.
- If the AR is greater than or equal to 110:100 and less than 160:100, the printer uses 125:100 AR.
- If the AR is greater than or equal to 225:100, the printer uses 250:100 AR.

In determining the pixel size, the printer attempts to preserve the aspect ratio without exceeding the selected Horizontal Grid Size.

When the 250:100 Aspect Ratio is selected and HGS is:

Ps3 Selection	Resulting Aspect Ratio (AR) and Horizontal Grid Size (HGS)
1/180"	Maintain 250:100 AR and HGS = 1/180"
1/140"	Maintain 250:100 AR and change to HGS = 1/180"
1/90"	Maintain 250:100 AR and HGS = 1/90"†
1/70"	Maintain 250:100 AR and change to HGS = 1/90"†
1/35"	Maintain 250:100 AR and change to HGS = 1/90"†

*Resultant image is full scale.

†Resultant image is twice full scale.

When the 200:100 Aspect Ratio is selected and HGS is:

Ps3 Selection	Resulting Aspect Ratio (AR) and Horizontal Grid Size (HGS)
1/180"	Change to 250:100 AR and maintain HGS = 1/180"
1/140"	Maintain 200:100 AR and HGS = 1/140"
1/90"	Maintain 200:100 AR and change to HGS = 1/140"
1/70"	Maintain 200:100 AR and HGS = 1/70"†
1/35"	Maintain 200:100 AR and change to HGS = 1/70"†

*Resultant image is full scale.

†Resultant image is twice full scale.

When the 125:100 Aspect Ratio is selected by Ps1, and the Ps3 parameter selects:

Ps3 Selection	Resulting Aspect Ratio (AR) and Horizontal Grid Size (HGS)
1/180"	Maintain 125:100 AR and HGS = 1/180"
1/140"	Maintain 125:100 AR and change to HGS = 1/180"
1/90"	Maintain 125:100 AR and HGS = 1/90"†
1/70"	Maintain 125:100 AR and change to HGS = 1/90"†
1/35"	Change to 100:100 AR and maintain HGS = 1/35"†

*Resultant image is full scale.

†Resultant image is twice full scale.

When the 100:100 Aspect Ratio is selected and HGS is:

P_s3 Selection	Resulting Aspect Ratio (AR) and Horizontal Grid Size (HGS)
1/180"	Maintain 100:100 AR and change to HGS = 1/140"
1/140"	Maintain 100:100 AR and HGS = 1/140"
1/90"	Maintain 100:100 AR and change to HGS = 1/140"
1/70"	Maintain 100:100 AR and HGS = 1/70"†
1/35"	Maintain 100:100 AR and HGS = 1/35"‡

*Resultant image is half full scale.

†Resultant image is full size.

‡Resultant image is twice full scale.

7.5.5 Color Introducer (#)

The Color Introducer control code starts a color selection sequence. The control code is followed by a color number and optional additional parameters. The format of the Color Introducer sequence is:

```
#   Pc   ;   Pu   ;   Px   ;   Py   ;   Pz  
23H  **  3BH  **  3BH  **  3BH  **  3BH  **
```

where:

= Color Introducer control character

Pc = Color number

Pu = Color coordinate system

Px = Hue angle or Red RGB coordinate

Py = Lightness or Green RGB coordinate

Pz = Saturation or Blue RGB coordinate.

This printer recognizes the format of the Color Introducer sequence but ignores it. Data following this sequence is printed, that is, all the one bits are printed and all the zero bits are not printed.

7.5.6 Graphic Carriage Return (\$)

The Graphic Carriage Return (GCR) control code \$ (24H) causes the active print position to return to the left-most position where the first Sixel data was printed after entering Sixel Graphics Mode. This feature allows overprinting lines of Sixel data starting at the same horizontal position. For example, if the first Sixel data was printed at column 10, the Graphic Carriage Return will cause the next line of Sixel data to start at column 10 and not at the left margin.

7.5.7 Graphic New Line (-)

The Graphic New Line (GNL) control code - (2DH) initiates printing of sixel graphics by:

- Returning the active print position to the graphic left margin.
- Advancing the paper by one Sixel line height (at current vertical grid size).

7.5.8 Numeric Parameters (0-9)

Some graphic control codes are followed by a numeric value (0-9 in the range of 30H - 39H). A numeric value is terminated by any non-digit, specifically another control code or a graphics printable character. The default value for any numeric parameter is zero.

7.5.9 Parameter Separator (;)

The parameter separator ; (3BH) is used to separate a series of numeric parameters. If a numeric value does not precede the separator, the value zero (0) is assumed. If a numeric value does not follow the separator, then the value zero (0) is assumed.

7.6 ASCII Control Characters

While in Sixel Mode, the printer ignores all C0 control characters except <CAN>, <SUB>, and <ESC>. The ST control code is a C1 control code. When these control codes are received, the printer performs the following actions:

Control Character	Printer Action
<CAN>	Leaves Sixel Graphics Mode, enters Text Mode, then processes <CAN> (18H)
<SUB>*	Processes <SUB> (1AH) as a Sixel space character (3FH) to limit communication line errors.
<ESC>	Leaves Sixel Graphics Mode, enters Text Mode, then processes <ESC> (1BH).
<ST>	Leaves Sixel Graphics Mode and enters Text Mode.

Note

All C1 control codes, if received in Sixel Graphics Mode, will cause the printer to leave the Sixel Graphics Mode. The printer then processes recognized C1 control codes.

7.7 String Terminator

The string terminator control character <ST> (9CH) is used to terminate the sixel protocol. Exit always returns to normal text processing.

ESC \ Seven-bit mode

1BH 5CH

ST Eight-bit mode

9CH

7.8 Entering Sixel Graphics Mode

On entering Sixel Graphics Mode, the active Sixel position is set equal to the ANSI text active position. The centre of the top dot is printed 70 decipoints above the character base line. Apart from the top, bottom, left and right margins, no information is carried from the ANSI text state. In particular, note that the SGR selections *do not* affect Sixels.

7.9 Leaving Sixel Graphics Mode

The conditions that force the printer to exit Sixel Graphics Mode are:

Control Character	Printer Action
<CAN> received	Exit from Sixel Graphics Mode
<ESC> received	Exit from Sixel Graphics Mode and begin processing the escape sequence.
<ST> received	Exit from Sixel Graphics Mode

Note

The printer prints all stored Sixel data before exiting from Sixel Graphics Mode. See also Section 7.6 for determining when to exit from Sixel Graphics Mode.

7.10 Printer State After Leaving Sixel Graphics

After exiting Sixel Mode, the printer will return with the following conditions:

1. Horizontal position returns to the last active position prior to entering Sixel Mode.
2. Horizontal pitch returns to the selection used prior to entering Sixel Mode.
3. Vertical position will be modified according to the control characters received while in Sixel Mode. Also, the first text mode vertical motion command (that is, <LF>, <VT>, and so on) will cause the printer to advance to the next text mode line before executing the command.
4. Vertical pitch returns to the selection used prior to entering the Sixel Mode.
5. All **SGR** attributes are restored to those selections used prior to entering Sixel Mode.

Chapter 8

VECTOR, BARCODE, AND BLOCK CHARACTER SEQUENCES

8.1 General

This chapter contains information that allows experienced programmers to implement vector drawing, barcode printing, and block character printing using the LG31 control sequences. Descriptions of vector drawing sequences can be found in Section 8.2; barcode and block character sequence descriptions can be found in Sections 8.3 and 8.4, respectively.

8.2 Drawing Vectors

This feature is selected by a control sequence and cannot be selected by the operator at the control panels. The LG31 is capable of drawing lines in accordance with the Digital Vector format (DECVEC). Vector commands are sent from the host in the form of control sequences. The user can select from the following vector parameters for printing.

- The x and y coordinates of the vector origin on the page.
- The direction of the vector from the origin (either the x or y direction).
- The length of the vector in decipoints.
- The width of the vector in decipoints.

Vector drawing does not affect the printer's active position. Vectors can only be printed in either the x or y direction (that is, no diagonal vectors).

This sequence defines and initiates the printing of vertical or horizontal lines on the page. Text margins do not apply to line drawing which can be printed up to the physical limits of the page. The printer draws vectors without modifying the active position.

7-bit Escape Sequence: <ESC>[Pn1;Pn2;..Pn5! |

Hex Value: 1B 5B Pn1 3B Pn2 3B..Pn5 21 7C

8-bit Control Sequence: <CSI> Pn1;Pn2;..Pn5! |

Hex Value: 9B Pn1 3B Pn2 3B..Pn5 21 7C

The Pn values are defined as follows:

- Pn1 selects a horizontal or vertical line (with respect to the shuttle orientation).

Pn1	Function
0/missing	Draws an x line (in the same direction of the shuttle motion).
1	Draws a y line (perpendicular to the direction of the shuttle motion).

- Pn2 specifies the x start position on the page in units of decipoints.
- Pn3 specifies the y start position on the page in units of decipoints.
- Pn4 specifies the line length in terms decipoints. A Pn4 value of zero results in a line of one decipoint in length.
- Pn5 specifies the line width in terms of decipoints. A Pn5 value of zero results in a line of one decipoint in Any other Pn values are illegal and cause the entire sequence to be ignored.

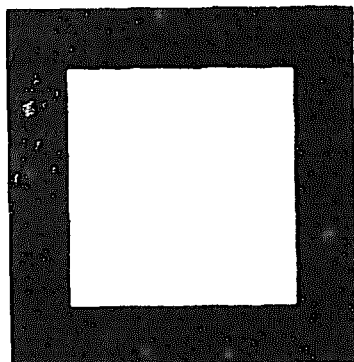
Note

For an x line, Pn4 specifies length in the x direction and Pn5 specifies width in the y direction. For a y line, Pn4 specifies length in the y direction and Pn5 specifies width in the x direction.

The following program shows how to use the vector sequence to generate the square in Figure 8-1.

```
<C/I>;30;2400;1200;120! |  
<C SI>;30;3480;1200;120! |  
<C SI>1;30;2400;1200;120! |  
<C SI>1;1100;2400;1200;120! |  
<FF>
```

Figure 8-1: Vector Drawing Example



RE UK00971A 89

8.3 Barcodes

This feature is selected by a control sequence and cannot be selected by the operator at the control panels.

The following barcodes are available for printing:

- Interleaved 2 of 5
- EAN 8
- Code 11
- Codabar b/n
- Codabar d/e
- UPC-A
- UPC-E

Barcode printing will commence on reception of the correct control sequence from the host. Subsequent printable characters from the host will be encoded and printed in the designated barcode format. Barcode printing mode will remain in operation until the correct disable barcode printing control sequence is received from the host.

Barcode attributes may be set using the Select Barcodes Attributes control sequence. This sequence may specify the following parameters:

- Barcode type (Code 39, Interleaved 2 of 5, ...)
- Width of narrow bars and spaces
- Width of quiet zone
- Width of wide bars and spaces
- Width of the intercharacter gap
- Height of the barcode
- Encoding of control characters in the barcode
- Orientation of the barcode (for example, portrait, landscape)
- Printing of readable characters (characters printed using a non-machine readable font).

These parameters remain in operation until changed by another control sequence to set barcode attributes.

These barcode fonts and algorithms are resident in the printer. The end barcodes printing control sequence restores the font selection and other attributes to the state before the barcodes control sequence was received (see Appendix D for details on barcodes and section on "Select Barcodes Attributes Sequence").

The process of printing multiple barcodes on one line is described in Section 8.3.4. Section 8.3.5 describes the size and spacing parameters for barcodes.

The barcodes sequences allow the setting of barcodes parameters, starting the generation of the barcodes, and stopping barcode printing.

8.3.1 Select Barcodes Attributes Sequence (DECSBCA)

This sequence defines the parameters for barcodes. If any parameters of the sequence are illegal, the sequence is ignored and the last barcodes parameters remain unchanged. When barcodes parameters are defined, they remain valid until:

- A new valid barcodes select parameter sequence is sent.
- A reset command (sets to default values).
- On power up, the default values are set.

7-bit Escape Sequence: <ESC>[Pn1;Pn2;..Pn9'q
Hex Value: 1B 5B Pn1 3B Pn2 3B..Pn9 27 71

8-bit Control Sequence: <CSI> Pn1;Pn2;..Pn9'q
Hex Value: 9B Pn1 3B Pn2 3B..Pn9 27 71

Where the Pn parameters are:

- Pn1 selects the type of barcode encoding.

Pn1	Function
0/missing	Code 39 (default value)
1	Interleaved 2 of 5
2	Code 39
4	EAN-8
5	EAN-11
6	Code 11
7	Codabar a/t
8	Codabar b/n
9	Codabar c/*
10	Codabar d/e
11	UPC-A
12	UPC-E

- Pn2 sets the width of the narrow bars and spaces in units of decipoints.

Minimum value = 12 decipoints (0.017 in.)
Maximum value = 756 decipoints (1.050 in.)
Default value = 12 decipoints (0.017 in.)

- Pn3 sets the width of the quiet zone in decipoints. The width of the quiet zone is permanently set set to 180 decipoints (0.25 in.) for leading edge and 180 decipoints (0.25 in.) for the trailing edge.

- Pn4 sets the width of the wide bars and wide spaces in decipoints.

Minimum value = 12 decipoints (0.017 in.)
Maximum value = 1524 decipoints (2.117 in.)
Default value = 36 decipoints (0.050 in.)

- Pn5 sets the intercharacter gap in decipoints.

Minimum value = 12 decipoints (0.017 in.)
Maximum value = 756 decipoints (1.050 in.)
Default value = 12 decipoints (0.017 in.)

- Pn6 sets the height of the bars in decipoints.

Minimum value = 60 decipoints (0.083 in.)
Maximum value = 7200 decipoints (10.000 in.)
Default value = 540 decipoints (0.750 in.)

- Pn7 defines the control character encoding character.

In the barcodes supported by the LG31, there are no control characters. Any value received in the position Pn7 is ignored.

- Pn8 sets the orientation for the barcodes. The barcode can be rotated in four orientations, but the characters under them are printed only in portrait or landscape orientation. The default value is 0.

Pn8	Function
0/missing	Horizontal (portrait)
1	Horizontal (portrait)
2	Vertical, rotation of -90 (landscape)
3	Vertical, rotation of +90
4	Horizontal, upside-down, rotation of 180

- Pn9 sets the alphanumeric character option.

Pn9	Function
0/missing	No alphanumeric characters printed
1	No alphanumeric characters printed
2	Alphanumeric characters printed
3	Alphanumeric characters printed
4	Alphanumeric characters printed

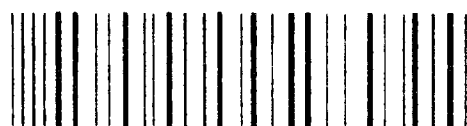
Note

When the alphanumeric characters are printed underneath the barcode, the format used is either the currently selected font, when printing in horizontal (portrait) mode, or a special font (one that is used for block characters) when the barcodes are rotated.

This program example shows how to use the barcode sequences to generate the barcode square in Figure 8–2.

```
Example:      <CSI>1;,,,,,3'q
              <ESC>% 00123456789
              <ESC>%@
              <FF>
```

Figure 8-2: Interleaved 2 of 5 Barcode Example



0123456789

RE 0000902A 89

8.3.2 Start Barcoding (DECBAR)

This sequence starts the generation of barcodes from the characters that follow the sequence. The barcode parameters are defined by the last Select Barcodes Attributes (DECSBCA) sequence. The printer continues to encode barcodes until the stop barcode sequence is received.

7-bit Escape Sequence: `<ESC>%<SP>0`

Hex Value: `1B 25 20 30`

The printer begins the barcode generation at the upper left-hand corner of the left quiet zone and ends at the lower right-hand corner of the right quiet zone. Barcodes that extend beyond the margins are truncated.

8.3.3 Stop Barcoding (DECBAR)

This sequence stops the generation of barcodes. The font selection and associated attributes are restored to the conditions prevailing before starting the barcodes printing.

7-bit Escape Sequence: `<ESC>%@`

Hex Value: `1B 25 40`

8.3.4 Multiple Barcodes

The LG31 can print multiple barcodes on the same line by using a sequence as shown below.

Sel	Print	Stop	SOME	Sel Next	Print	Stop
Barcode	Barcode	Barcode	SPACES	Barcode	Barcode	Barcode
=====						

Using this method to print multiple barcodes results in the barcodes being printed on one line, but by means of multiple passes. Therefore, print the first barcode, reverse the paper, and then print the next barcode.

Multiple barcodes can be printed on the same horizontal line in one pass by using delimiters. The three delimiters that can be used are the space, the comma (,), and the horizontal tab characters. Each space character adds 0.1 inches between the barcodes. A comma does not add any space, and the horizontal tab adds white space relative to the tab settings.

Sel	Print		Print	Stop
Barcode	Barcode	Delimiters	Barcode	Barcode
=====				

8.3.5 Size and Spacing Between Barcodes

8.3.5.1 Horizontal Barcodes (0 and 180 Degree Rotation)

The width of a horizontal barcode is determined by of the number of characters in the barcode symbol, the style of the barcode symbol, and the ratio of the wide light and dark bars to the narrow light and dark bars. The barcode height has a default value of 0.75 inch. This does not include the alphanumeric line. If the alphanumeric line is printed, a gap of 0.1 inch is inserted between the bottom of the barcode symbol and the alphanumeric line.

Horizontal barcodes (0 and 180 degree rotation) are printed at 120 Dots Per Inch (DPI) horizontally and 144 DPI vertically.

Horizontal Spacing Between Horizontal Barcodes

There is a 0.25 inch leading and trailing space before and after a barcode symbol and a 0.25 inch trailing space after a barcode symbol. These spaces are quiet zones. Therefore, there will be at least 0.5 inch space between the stop and the start of any two barcodes.

If a line of input, that is the width of the encoded barcode symbol plus any spacing code symbol, exceeds the right margin (whatever part can be printed), then the rest of the barcode is truncated. In the alphanumeric line, a diamond appears at the point where the barcode could not be continued.

Vertical Spacing Between Horizontal Barcodes

If the alphanumeric line is printed, there is at least the vertical inter-character gap between the alphanumeric line and the top of a barcode symbol on the next line, plus any line feeds.

If there is no alphanumeric line, then the vertical spacing is the inter-character gap plus the line feed.

The vertical limit for a barcode symbol is 10 inches. When the alphanumeric line is printed, the 0.1 inch gap plus character size and the barcode symbol is the total vertical distance.

8.3.5.2 Vertical Barcodes (90 and 270 Degree Rotation)

The width of the rotated barcode is equal to the height of the original horizontal barcode. If the alphanumeric line is printed, it is included in the total horizontal distance traveled.

The vertical height of the rotated barcode includes the 0.25 inch leading space, the light and dark bars that make up the symbol, and the 0.25 inch trailing space.

Vertical barcodes are printed with a horizontal density of 120 DPI and a vertical density of 144 DPI.

Horizontal Spacing Between Vertical Barcodes

You must ensure proper horizontal spacing between two vertical barcodes. Note that the leading and trailing spaces are also rotated with the vertical barcodes.

Once again the horizontal limit is the width of the paper, which is 13.2 inches. In the case of rotated barcodes where "N" barcode symbols are being printed and HEIGHT equals the height entered in as a parameter for the original barcode,

$(N) * (\text{HEIGHT}) + \text{any spacing between two or more symbols}$

must be less than or equal to 13.2 inches.

If an alphanumeric line is printed, it is also included when computing the total horizontal distance.

If a barcode exceeds the right margin, what can be printed is printed. Nothing else is done to flag the user.

Vertical Spacing Between Vertical Barcodes

Vertical spacing is set by line feeds. The vertical limit of any vertical barcode (90 or 270 degree rotation) is the current forms length. For a line of ASCII input, the resulting encoded barcode symbol (including the quiet zones) is less than or equal to the current printable forms length. If forms length is exceeded, the barcode symbol is printed as far as possible and if an alphanumeric line is printed, a diamond is printed where printing was no longer able to continue.

8.4 Block Characters

This feature is selected by using the appropriate control sequence and is not selected at the operator control panels.

The LG31 is capable of printing block characters in accordance with the DIGITAL block character format (**DECBCS** and **DECBCM**). Block character attributes are sent from the host in the form of control sequences. The size of the block character to be printed is specified within the control sequence in the form of horizontal and vertical magnification factors.

The following block character parameters are selectable.

- Horizontal magnification factor
- Vertical magnification factor
- Inverse video characters
- National Replacement Character Sets

The control characters **<CAN>** (18H) and **<SUB>** (1AH) cause the printer to exit from the block character mode. Block characters which extend beyond the right margin and the bottom margin will be truncated.

Block characters are not governed by the spacing or the pitch select commands. Print attributes (such as bolding, underline, autowrap) do not apply to the block characters.

The block character sequences define the parameters of the block characters, initiates the generation of block characters and exits back to normal printing.

8.4.1 Setting Block Character Parameters (DECBCS)

This sequence defines the parameters for block characters.

7-bit Escape Sequence: <ESC>[Pn1;Pn2;..P5'r

Hex Value: 1B 5B Pn1 3B P2 3B..P5 27 72

8-bit Control Sequence: <CSI>[Pn1;Pn2;..P5'r

Hex Value: 9B Pn1 3B P2 3B..P5 27 72

If any parameters (Pn1 - Pn5) are illegal, the entire sequence is ignored. When block character parameters are defined, they remain valid until:

- A new valid block character select parameter sequence is sent.
- A reset command occurs (sets the default values).
- On power up, the default values are set.

The Pn parameters define the height, width, background color and character set of the block characters.

The magnification values specified in P1 and P2 operate on the basic character cell.

The character exists entirely and centrally within the character cell. The line feed distance is equal to the basic cell height multiplied by the vertical magnification factor. The distance between the character cells is 3/16 in multiplied by the magnification factor.

- Pn1 defines the horizontal magnification factor.

Pn1	Function
0/1/missing	Magnification of 2 (default)
2 - 156	Defines the horizontal magnification factor
> 156	Maximum value used

- Pn2 defines the vertical magnification factor. The maximum value is limited by the page length.

Pn2	Function
0/1/missing	Magnification of 2 (default)
2 - 156	Defines the vertical magnification factor
> 156	Sequence ignored maximum value used

- Pn3 defines the background.

Pn3	Function
0/missing	White background (default)
1*	Black background (inverse video)

- Pn4 is the international character set designator.

Pn4	Function
0/missing	U.S. ASCII (default)
1	Germany
2	DEC Norway/Denmark
3	France
4	UK
5	Spain
6	Sweden

- Pn5 specifies the orientation of the block characters.

Pn5	Function
0/missing	Portrait (0 degree rotation)
1	Portrait (0 degree rotation)
2	Landscape (90 degree rotation)
3*	Reverse landscape (270 degree rotation)
4	Portrait upside-down (180 degree rotation)

Note

When the sequence selects character rotation, each of the characters is rotated about its axis by the specified amount.

- * When selecting inverse video, surround the text with spaces to achieve good effect (see Figure 8-3).

8.4.2 Start Block Character Mode (DECBCM)

The start block character sequence starts the generation of block characters from the characters immediately following the sequence.

7-bit Escape Sequence: <ESC>%<SP>1

Hex Value: 1B 25 20 31

Figure 8–3: Block Character Examples

BLOCK CHARACTERS

A. BLACK ON WHITE

BLACK BACKGROUND

B. WHITE ON BLACK

C. LANDSCAPE ORIENTATION

LANDSCAPE

FIG. UN002760 00

The block character parameters are defined from the last defined block character parameters. If no prior sequence has been defined, this sequence will be printed with a 0 degree rotation, in U.S. ASCII character set, a horizontal and vertical magnification factor of 2, with a white background.

The program examples show how to use the block character sequences to generate the block characters in Figure 8-3.

Example A: <CSI>3;3;0;0;0'r
 <ESC>% 1 BLOCK CHARACTERS
 <ESC>%@

Example B: <CSI>4;2;1;0;0'r
 <ESC>% 1 BLOCK CHARACTERS
 <ESC>%@

Example C: <CSI>2;4;0;0;2'r
 <ESC>% 1 BLOCK CHARACTERS
 <ESC>%@

8.4.3 Stop Block Character Mode (DECBCM)

The stop block character sequence stops the generation of block characters.

7-bit Escape Sequence: <ESC>%@

Hex Value: 1B 25 40

The font attributes, Characters-Per-Inch (CPI) and Lines-Per-Inch (LPI) set prior to entering the block character mode, will be restored.

[illegible][illegible]

Appendix A

CHARACTER SETS

Figures A-1 to A-18 show the 18 character sets supported by the LG31 printer.

Figure	Character Set
A-1	U.S. ASCII
A-2	Digital Great Britain
A-3	Digital Finnish
A-4	French
A-5	Digital French Canadian
A-6	ISO German
A-7	ISO Italian
A-8	JIS Roman (Japanese)
A-9	Digital Norwegian/Danish
A-10	ISO Spanish
A-11	Digital Swedish
A-12	VT100 Special Graphics
A-13	Digital Technical Set
A-14	ISO Norwegian/Danish
A-15	Digital Dutch
A-16	Digital Swiss
A-17	Digital Portuguese
A-18	Digital Supplemental

Figure A-1: U.S. ASCII Character Set

BITS					COLUMN		1	2	3	4	5	6	7
B7 B6 B5					0		0	0	0	1	0	1	1
ROW	B4	B3	B2	B1	0		0	1	0	1	0	1	0
0	0	0	0	0	NUL	0	20	SP	40	0	60	@	100
						0	16		32		48		120
						0	10		20		30		80
1	0	0	0	1		1	21		41		61		141
					DC1 (XON)	1	17	!	33	1	49	A	101
						1	11		21		31		81
2	0	0	1	0		2	22	"	42	2	50	B	102
						2	18		34		44		122
						2	12		22		32		82
3	0	0	1	1		3	23	#	43	3	51	C	103
					DC3 (XOFF)	3	19		35		45		123
						3	13		23		33		83
4	0	1	0	0		4	24	\$	44	4	52	D	104
						4	20		36		46		124
						4	14		24		34		84
5	0	1	0	1		5	25	%	45	5	53	E	105
						5	21		37		47		125
						5	15		25		35		85
6	0	1	1	0		6	26	&	46	6	54	F	106
						6	22		38		48		126
						6	16		26		36		86
7	0	1	1	1		7	27	'	47	7	55	G	107
						7	23		39		49		127
						7	17		27		37		87
8	1	0	0	0	BS	10	30		50	8	56	H	110
					CAN	8	24	(	40		52		120
						8	18		28		38		88
9	1	0	0	1	HT	11	31		51	9	57	I	111
						9	25	)	41		53		121
						9	19		29		39		89
10	1	0	1	0	LF	12	32	*	52		58	J	112
					SUB	10	26		42	:	54		122
						A	1A		2A		3A		8A
11	1	0	1	1	VT	13	33	+	53		59	K	113
					ESC	11	27		43	;-	55		123
						B	1B		2B		3B		8B
12	1	1	0	0	FF	14	34	,	54		60	L	114
						12	28		44	<	50		124
						C	1C		2C		3C		8C
13	1	1	0	1	CR	15	35	.	55		61	M	115
						13	29		45	=	51		125
						D	1D		2D		3D		8D
14	1	1	1	0	SO	16	36	.	56		62	N	116
						14	30		46	>	52		126
						E	1E		2E		3E		8E
15	1	1	1	1	SI	17	37	/	57	?	63	O	117
						15	31		47		53		127
						F	1F		2F		3F		8F

KEY

ASCII CHARACTERS

ESC

1/11

33

27

18

COLUMN ROW

OCTAL

DECIMAL

HEX

RE UK00048M 89

Figure A-2: Digital Great Britain Character Set

BITS					COLUMN	1	2	3	4	5	6	7	
B7 B6 B5					0	0	0	0	1	1	1	1	
ROW	B4	B3	B2	B1	0	0	0	0	0	0	0	0	
0	0	0	0	0	NUL	0	20	40	60	100	120	140	160
					0	16	32	48	64	80	96	112	128
					0	10	20	30	40	50	60	70	80
1	0	0	0	1	1	21	41	61	101	121	141	161	181
					1	17	33	49	65	81	97	113	129
					1	11	21	31	41	51	61	71	81
2	0	0	1	0	2	22	42	62	102	122	142	162	182
					2	18	34	50	66	82	98	114	130
					2	12	22	32	42	52	62	72	82
3	0	0	1	1	3	23	43	63	103	123	143	163	183
					3	19	35	51	67	83	99	115	131
					3	13	23	33	43	53	63	73	83
4	0	1	0	0	4	24	44	64	104	124	144	164	184
					4	20	36	52	68	84	100	116	132
					4	14	24	34	44	54	64	74	84
5	0	1	0	1	5	25	45	65	105	125	145	165	185
					5	21	37	53	69	85	101	117	133
					5	15	25	35	45	55	65	75	85
6	0	1	1	0	6	26	46	66	106	126	146	166	186
					6	22	38	54	70	86	102	118	134
					6	16	26	36	46	56	66	76	86
7	0	1	1	1	7	27	47	67	107	127	147	167	187
					7	23	39	55	71	87	103	119	135
					7	17	27	37	47	57	67	77	87
8	1	0	0	0	BS	30	50	70	110	130	150	170	190
					8	24	40	56	72	88	104	120	136
					8	18	28	38	48	58	68	78	88
9	1	0	0	1	HT	31	51	71	111	131	151	171	191
					9	25	41	57	73	89	105	121	137
					9	19	29	39	49	59	69	79	89
10	1	0	1	0	LF	32	52	72	112	132	152	172	192
					10	26	42	58	74	90	106	122	138
					A	1A	2A	3A	4A	5A	6A	7A	8A
11	1	0	1	1	VT	33	53	73	113	133	153	173	193
					11	27	43	59	75	91	107	123	139
					B	1B	2B	3B	4B	5B	6B	7B	8B
12	1	1	0	0	FF	34	54	74	114	134	154	174	194
					12	28	44	60	76	92	108	124	140
					C	1C	2C	3C	4C	5C	6C	7C	8C
13	1	1	0	1	CR	35	55	75	115	135	155	175	195
					13	29	45	61	77	93	109	125	141
					D	1D	2D	3D	4D	5D	6D	7D	8D
14	1	1	1	0	SO	36	56	76	116	136	156	176	196
					14	30	46	62	78	94	110	126	142
					E	1E	2E	3E	4E	5E	6E	7E	8E
15	1	1	1	1	SI	37	57	77	117	137	157	177	197
					15	31	47	63	79	95	111	127	143
					F	1F	2F	3F	4F	5F	6F	7F	8F

KEY

ASCII CHARACTERS

ESC

1/11
33
27
18

COLUMN ROW
OCTAL
DECIMAL
HEX



HIGHLIGHTS DIFFERENCES
FROM ASCII

RE UK00306M 00

Figure A-3: Digital Finnish Character Set

BITS					COLUMN	1	2	3	4	5	6	7
B7	B6	B5	0		0	0	0	0	1	1	1	1
B4	B3	B2	B1	0	0	1	0	1	0	1	0	1
ROW												
0	0	0	0	0	NUL	20	SP	0	@	P	é	p
						16		32	48	80	96	112
						10		20	30	40	60	70
1	0	0	0	1		21	!	41	61	101	121	141
					DC1 (XON)	17		33	49	85	101	113
						11		21	31	41	51	71
2	0	0	1	0		22	"	42	62	102	122	142
						18		34	50	86	102	114
						12		22	32	42	52	72
3	0	0	1	1		23	#	43	63	103	123	143
					DC3 (XOFF)	19		35	51	87	103	115
						13		23	33	43	53	73
4	0	1	0	0		24	\$	44	64	104	124	144
						20		36	52	88	104	116
						14		24	34	44	54	74
5	0	1	0	1		25	%	45	65	105	125	145
						21		37	53	89	105	117
						15		25	35	45	55	75
6	0	1	1	0		26	&	46	66	106	126	146
						22		38	54	90	106	118
						16		26	36	46	56	76
7	0	1	1	1		27	'	47	67	107	127	147
						23		39	55	91	107	119
						17		27	37	47	57	77
8	1	0	0	0	BS	30	CAN	50	70	110	130	150
						24		40	56	92	108	120
						18		28	38	48	58	78
9	1	0	0	1	HT	31	)	51	71	111	131	151
						25		41	57	93	109	121
						19		29	39	49	59	79
10	1	0	1	0	LF	32	*	52	72	112	132	152
					SUB	26		42	58	94	110	122
						1A		2A	3A	4A	5A	7A
11	1	0	1	1	VT	33	+	53	73	113	133	153
					ESC	27		43	59	95	111	123
						1B		2B	3B	4B	5B	7B
12	1	1	0	0	FF	34	,	54	74	114	134	154
						28		44	60	96	112	124
						1C		2C	3C	4C	5C	7C
13	1	1	0	1	CR	35	-	55	75	115	135	155
						29		45	61	97	113	125
						1D		2D	3D	4D	5D	7D
14	1	1	1	0	SO	36	.	56	76	116	136	156
						30		46	62	98	114	126
						1E		2E	3E	4E	5E	7E
15	1	1	1	1	SI	37	/	57	77	117	137	157
						31		47	63	99	115	127
						1F		2F	3F	4F	5F	7F

KEY

ASCII CHARACTERS

ESC

1/11

33

27

18

COLUMN ROW

OCTAL

DECIMAL

HEX



HIGHLIGHTS DIFFERENCES FROM ASCII

Figure A-4: French Character Set

BITS				COLUMN		1	2	3	4	5	6	7
B7	B6	B5		0								
0	0	0	0	0	0	0	0	0	1	1	1	1
ROW	B4	B3	B2	B1								
0	0	0	0	0	NUL	20	SP	40	à	100	P	140
						16		32	â	84		96
						10		20	ä	50		60
1	0	0	0	1		21	!	41	À	101	Q	141
					DC1 (XON)	17		33	Á	65		81
						11		21	Â	41		51
2	0	0	1	0		22	"	42	B	102	R	142
						18		34	ß	66		82
						12		22	Ç	42		52
3	0	0	1	1		23	£	43	C	103	S	143
					DC3 (XOFF)	19		35	È	67		83
						13		23	É	43		53
4	0	1	0	0		24	\$	44	D	104	T	144
						20		36	Ê	68		84
						14		24	Ë	44		54
5	0	1	0	1		25	%	45	E	105	U	145
						21		37	Ï	69		85
						15		25	Ü	45		55
6	0	1	1	0		26	&	46	F	106	V	146
						22		38	Ö	70		86
						16		26	Ù	46		56
7	0	1	1	1		27	'	47	G	107	W	147
						23		39	Ç	71		87
						17		27	È	47		57
8	1	0	0	0	BS	30	CAN	50	H	110	X	150
						24	(	40	Ï	72		88
						18		28	Ï	48		58
9	1	0	0	1	HT	31	)	51	I	111	Y	151
						25		41	Ï	73		89
						19		29	Ï	49		59
10	1	0	1	0	LF	32	SUB	52	J	112	Z	152
						26	*	42	Ï	74		90
					A	1A		2A	Ï	4A		5A
11	1	0	1	1	VT	33	ESC	53	K	113	°	153
						27	+	43	Ï	75		91
					B	1B		2B	Ï	4B		5B
12	1	1	0	0	FF	34		54	L	114	ç	154
						28	,	44	Ï	76		92
					C	1C		2C	Ï	4C		5C
13	1	1	0	1	CR	35	-	55	M	115	\$	155
						29		45	Ï	77		93
					D	1D		2D	Ï	4D		5D
14	1	1	1	0	SO	36	.	56	N	116	À	156
						30		46	Ï	78		94
					E	1E		2E	Ï	4E		5E
15	1	1	1	1	SI	37	/	57	O	117	—	157
						31		47	Ï	79		95
					F	1F		2F	Ï	4F		5F

KEY

ASCII CHARACTERS

ESC	1/11
	33
	27
	18

COLUMN ROW
OCTAL
DECIMAL
HEX



HIGHLIGHTS DIFFERENCES FROM ASCII

NOTE
QUOTATION MARKS (") ARE USED AS AN APPROXIMATION FOR THE DIAERESIS MARK (¨), COLUMN 7/ROW 14.

RE_UFG00000M_00

Figure A-5: Digital French Canadian Character Set

BITS					COLUMN		1	2	3	4	5	6	7				
B7 B6 B5					0	0	0	0	0	1	1	1	1				
ROW B4 B3 B2 B1					0	0	1	0	1	0	1	0	1				
0	0	0	0	0	NUL	0	20	SP	40	à	100	P	120	ô	140	p	160
						0	16		32	â	64		80	ö	96		112
						0	10		20	ä	40		50	ü	60		70
1	0	0	0	1		1	21	!	41	1	101	Q	121	ä	141	q	161
						1	17		33	Ä	65		81	ö	97		113
						1	11		21	Å	41		51	ü	61		71
2	0	0	1	0		2	22	"	42	2	102	R	122	b	142	r	162
						2	18		34	B	66		82	ë	98		114
						2	12		22	ß	42		52	ö	62		72
3	0	0	1	1		3	23	#	43	3	103	S	123	c	143	s	163
						3	19		35	C	67		83	ç	99		115
						3	13		23	Ç	43		53	ö	63		73
4	0	1	0	0		4	24	\$	44	4	104	T	124	d	144	t	164
						4	20		36	D	68		84	ë	100		116
						4	14		24	Ä	44		54	ü	64		74
5	0	1	0	1		5	25	%	45	5	105	U	125	e	145	u	165
						5	21		37	E	69		85	ë	101		117
						5	15		25	Ë	45		55	ü	65		75
6	0	1	1	0		6	26	&	46	6	106	V	126	f	146	v	166
						6	22		38	F	70		86	ï	102		118
						6	16		26	V	46		56	ö	66		76
7	0	1	1	1		7	27	'	47	7	107	W	127	g	147	w	167
						7	23		39	G	71		87	ë	103		119
						7	17		27	G	47		57	ö	67		77
8	1	0	0	0	BS	8	30	CAN	50	70	110	X	130	h	150	x	170
						8	24	(	40	8	72		88	ë	104		120
						8	18		28	H	48		58	ö	68		78
9	1	0	0	1	HT	9	31	)	51	71	111	Y	131	i	151	y	171
						9	25		41	I	73		89	ë	105		121
						9	19		29	I	49		59	ö	69		79
10	1	0	1	0	LF	10	32	*	52	:	72	J	112	j	152	z	172
						10	26		42	:	58		74	ë	106		122
						10	1A		2A	J	4A		5A	ö	6A		7A
11	1	0	1	1	VT	11	33	+	53	;	73	K	113	ë	133	é	173
						11	27		43	;	59		75	ë	107		123
						11	1B		2B	K	4B		5B	ö	6B		7B
12	1	1	0	0	FF	12	34	,	54	<	74	L	114	ç	134	ù	174
						12	28		44	<	60		76	ë	108		124
						12	1C		2C	L	4C		5C	ö	6C		7C
13	1	1	0	1	CR	13	35	-	55	=	75	M	115	ë	135	ë	175
						13	29		45	=	61		77	ë	109		125
						13	1D		2D	M	4D		5D	ö	6D		7D
14	1	1	1	0	SO	14	36	.	56	>	76	N	116	ï	136	ö	176
						14	30		46	>	62		78	ë	110		126
						14	1E		2E	N	4E		5E	ö	6E		7E
15	1	1	1	1	SI	15	37	/	57	?	77	O	117	—	137	DEL	177
						15	31		47	?	63		79	ë	111		127
						15	1F		2F	O	4F		5F	ö	6F		7F

KEY

ASCII CHARACTERS

ESC

17H

33

27

18

COLUMN ROW

OCTAL

DECIMAL

HEX



HIGHLIGHTS DIFFERENCES FROM ASCII

Figure A-6: ISO German Character Set

BITS					COLUMN		0	1	2	3	4	5	6	7	
B7 B6 B5					0		0	0	0	0	1	1	1	1	
ROW B4 B3 B2 B1					0		0	1	0	1	0	0	1	0	1
0	0	0	0	0	NUL	0	20	SP	40	0	60	100	120	140	160
						0	18		32	48	§	64	P	80	p
						0	10		20	30		40		50	70
1	0	0	0	1		1	21	!	41	1	61	101	121	141	161
						1	17		33	49	A	65	Q	81	a
						1	11		21	31		41		51	q
2	0	0	1	0		2	22	"	42	2	62	102	122	142	162
						2	18		34	50	B	66	R	82	b
						2	12		22	32		42		52	r
3	0	0	1	1		3	23	§	43	3	63	103	123	143	163
						3	19		35	51	C	67	S	83	c
						3	13		23	33		43		53	s
4	0	1	0	0		4	24	\$	44	4	64	104	124	144	164
						4	20		36	52	D	68	T	84	d
						4	14		24	34		44		54	t
5	0	1	0	1		5	25	%	45	5	65	105	125	145	165
						5	21		37	53	E	69	U	85	e
						5	15		25	35		45		55	u
6	0	1	1	0		6	26	&	46	6	66	106	126	146	166
						6	22		38	54	F	70	V	86	f
						6	16		26	36		46		56	v
7	0	1	1	1		7	27	'	47	7	67	107	127	147	167
						7	23		39	55	G	71	W	87	g
						7	17		27	37		47		57	w
8	1	0	0	0	BS	10	30	CAN	50	8	70	110	130	150	170
						8	24	(	40	56	H	72	X	88	x
						8	18		28	38		48		58	78
9	1	0	0	1	HT	11	31	)	51	9	71	111	131	151	171
						9	25		41	57	I	73	Y	89	y
						9	19		29	39		49		59	79
10	1	0	1	0	LF	12	32	SUB	52	10	72	112	132	152	172
						10	26	*	42	58	J	74	Z	90	z
						A	1A		2A	3A		4A		5A	7A
11	1	0	1	1	VT	13	33	ESC	53	11	73	113	133	153	173
						11	27	+	43	59	K	75	Ä	91	ä
						B	1B		2B	3B		4B		5B	7B
12	1	1	0	0	FF	14	34	,	54	12	74	114	134	154	174
						12	28		44	60	L	76	Ö	92	ö
						C	1C		2C	3C		4C		5C	7C
13	1	1	0	1	CR	15	35	-	55	13	75	115	135	155	175
						13	29		45	61	M	77	Ü	93	ü
						D	1D		2D	3D		4D		5D	7D
14	1	1	1	0	SO	16	36	.	56	14	76	116	136	156	176
						14	30		46	62	N	78	À	94	à
						E	1E		2E	3E		4E		5E	7E
15	1	1	1	1	SI	17	37	/	57	15	77	117	137	157	177
						15	31		47	63	O	79	—	95	DEL
						F	1F		2F	3F		4F		5F	7F

KEY

ASCII CHARACTERS

ESC

1/11

COLUMN ROW

OCTAL

DECIMAL

HEX

HIGHLIGHTS DIFFERENCES FROM ASCII

Figure A-7: ISO Italian Character Set

BITS					COLUMN		1	2	3	4	5	6	7
B7 B6 B5 B4 B3 B2 B1					0		0	0	0	0	0	0	0
ROW					0		0	0	0	0	0	0	0
0	0	0	0	0	NUL	0	20	40	60	100	120	140	160
						5	5	32	48	84	80	96	112
						10	10	20	30	40	50	60	70
1	0	0	0	1		1	21	41	61	101	121	141	161
						17	17	33	49	85	81	97	113
						11	11	21	31	41	51	61	71
2	0	0	1	0		2	22	42	62	102	122	142	162
						2	18	34	50	86	82	98	114
						2	12	22	32	42	52	62	72
3	0	0	1	1		3	23	43	63	103	123	143	163
						19	19	35	51	87	83	99	115
						3	13	23	33	43	53	63	73
4	0	1	0	0		4	24	44	64	104	124	144	164
						4	20	36	52	88	84	100	116
						4	14	24	34	44	54	64	74
5	0	1	0	1		5	25	45	65	105	125	145	165
						5	21	37	53	89	85	101	117
						5	15	25	35	45	55	65	75
6	0	1	1	0		6	26	46	66	106	126	146	166
						6	22	38	54	90	86	102	118
						6	16	26	36	46	56	66	76
7	0	1	1	1		7	27	47	67	107	127	147	167
						7	23	39	55	91	87	103	119
						7	17	27	37	47	57	67	77
8	1	0	0	0	BS	8	30	50	70	110	130	150	170
						8	24	40	56	92	88	104	120
						8	18	28	38	48	58	68	78
9	1	0	0	1	HT	9	31	51	71	111	131	151	171
						9	25	41	57	93	89	105	121
						9	19	29	39	49	59	69	79
10	1	0	1	0	LF	10	32	52	72	112	132	152	172
						10	26	42	58	94	90	106	122
						10	20	30	40	50	60	70	80
11	1	0	1	1	VT	11	33	53	73	113	133	153	173
						11	27	43	59	95	91	107	123
						11	21	31	41	51	61	71	81
12	1	1	0	0	FF	12	34	54	74	114	134	154	174
						12	28	44	60	96	92	108	124
						12	22	32	42	52	62	72	82
13	1	1	0	1	CR	13	35	55	75	115	135	155	175
						13	29	45	61	97	93	109	125
						13	23	33	43	53	63	73	83
14	1	1	1	0	SO	14	36	56	76	116	136	156	176
						14	30	46	62	98	94	110	126
						14	24	34	44	54	64	74	84
15	1	1	1	1	SI	15	37	57	77	117	137	157	177
						15	31	47	63	99	95	111	127
						15	25	35	45	55	65	75	85

KEY

ASCII CHARACTERS

ESC	1/11
	33
	27
	18

COLUMN ROW
OCTAL
DECIMAL
HEX



HIGHLIGHTS DIFFERENCES
FROM ASCII

RE UK00637M 88

Figure A-8: JIS Roman (Japanese) Character Set

BITS					COLUMN		0	1	2	3	4	5	6	7
B7	B6	B5	B4	B3	B2	B1	0	0	0	0	1	1	1	1
ROW	B4	B3	B2	B1			0	0	0	0	0	0	0	0
0	0	0	0	0			NUL	0	20	SP	40	60	100	160
							0	16	32	0	48	64	80	112
							0	10	20		30	40	50	70
1	0	0	0	1			1	21	41		61	101	121	161
							1	17	33	!	49	65	81	113
							1	11	21	1	31	41	51	71
2	0	0	1	0			2	22	42	"	62	102	122	162
							2	18	34	2	50	66	82	114
							2	12	22		32	42	52	72
3	0	0	1	1			3	23	43		63	103	123	163
							3	19	35	3	51	67	83	115
							3	13	23		33	43	53	73
4	0	1	0	0			4	24	44	\$	64	104	124	164
							4	20	36	4	52	68	84	116
							4	14	24		34	44	54	74
5	0	1	0	1			5	25	45	%	65	105	125	165
							5	21	37	5	53	69	85	117
							5	15	25		35	45	55	75
6	0	1	1	0			6	26	46	&	66	106	126	166
							6	22	38	6	54	70	86	118
							6	16	26		36	46	56	76
7	0	1	1	1			7	27	47	'	67	107	127	167
							7	23	39	7	55	71	87	119
							7	17	27		37	47	57	77
8	1	0	0	0			8	30	50	(	70	110	130	170
							8	24	40	8	58	72	88	120
							8	18	28		38	48	58	78
9	1	0	0	1			9	31	51	)	71	111	131	171
							9	25	41	9	57	73	89	121
							9	19	29		39	49	59	79
10	1	0	1	0			10	32	52	*	72	112	132	172
							10	26	42	:	58	74	90	122
							10	20	30		3A	4A	5A	7A
11	1	0	1	1			11	33	53	+	73	113	133	173
							11	27	43	;	59	75	91	123
							11	21	31		3B	4B	5B	7B
12	1	1	0	0			12	34	54	,	74	114	134	174
							12	28	44	<	60	76	92	124
							12	22	32		3C	4C	5C	7C
13	1	1	0	1			13	35	55	=	75	115	135	175
							13	29	45	=	61	77	93	125
							13	23	33		3D	4D	5D	7D
14	1	1	1	0			14	36	56	>	76	116	136	176
							14	30	46		62	78	94	126
							14	24	34		3E	4E	5E	7E
15	1	1	1	1			15	37	57	/	77	117	137	177
							15	31	47	?	63	79	95	127
							15	25	35		3F	4F	5F	7F

KEY

ASCII CHARACTERS

ESC

1/11

33

27

18

COLUMN ROW

OCTAL

DECIMAL

HEX



HIGHLIGHTS DIFFERENCES FROM ASCII

RE UK00838M 00

Figure A-9: Digital Norwegian/Danish Character Set

BITS ROW B4 B3 B2 B1	COLUMN							
	0	1	2	3	4	5	6	7
	B7 0 B6 0 B5 0	0 0 1	0 1 0	0 1 1	1 0 0	1 0 1	1 1 0	1 1 1
0 0 0 0 0	NUL		SP	0	Å	P	å	p
1 0 0 0 1		DC1 (XON)	!	1	A	Q	a	q
2 0 0 1 0			"	2	B	R	b	r
3 0 0 1 1		DC3 (XOFF)	#	3	C	S	c	s
4 0 1 0 0			\$	4	D	T	d	t
5 0 1 0 1			%	5	E	U	e	u
6 0 1 1 0			&	6	F	V	f	v
7 0 1 1 1			'	7	G	W	g	w
8 1 0 0 0	BS	CAN	(	8	H	X	h	x
9 1 0 0 1	HT		)	9	I	Y	i	y
10 1 0 1 0	LF	SUB	*		J	Z	j	z
11 1 0 1 1	VT	ESC	+		K	Æ	k	æ
12 1 1 0 0	FF		,		L	Ø	l	ø
13 1 1 0 1	CR		-		M	Å	m	å
14 1 1 1 0	SO		.		N	Ö	n	ö
15 1 1 1 1	SI		/		O	—	o	DEL

KEY			
ASCII CHARACTERS	ESC	1 11	COLUMN ROW
		33	OCTAL
		27	DECIMAL
		1B	HEX
			HIGHLIGHTS DIFFERENCES FROM ASCII

RE JK00639M 09

Figure A-10: ISO Spanish Character Set

BITS					COLUMN	1	2	3	4	5	6	7	
B7 B6 B5					0	0	0	0	1	1	1	1	
ROW	B4	B3	B2	B1	0	1	0	1	0	1	0	1	
0	0	0	0	0	NUL	20	SP	40	60	100	120	140	160
					0	16	32	48	84	90	96	p	112
					0	10	20	30	40	50	60	70	
1	0	0	0	1	DC1 (XON)	21	!	41	61	101	121	141	161
					1	17	33	49	A	65	81	a	97
					1	11	21	31	41	51	61	71	q
2	0	0	1	0		22	"	42	62	102	122	142	162
					2	18	34	50	B	66	82	b	98
					2	12	22	32	42	52	62	72	r
3	0	0	1	1	DC3 (XOFF)	23	£	43	63	103	123	143	163
					3	19	35	51	C	67	83	c	99
					3	13	23	33	43	53	63	73	s
4	0	1	0	0		24	\$	44	64	104	124	144	164
					4	20	36	52	D	68	84	d	100
					4	14	24	34	44	54	64	74	t
5	0	1	0	1		25	%	45	65	105	125	145	165
					5	21	37	53	E	69	85	e	101
					5	15	25	35	45	55	65	75	u
6	0	1	1	0		26	&	46	66	106	126	146	166
					6	22	38	54	F	70	86	f	102
					6	16	26	36	46	56	66	76	v
7	0	1	1	1		27	'	47	67	107	127	147	167
					7	23	39	55	G	71	87	g	103
					7	17	27	37	47	57	67	77	w
8	1	0	0	0	BS	30	(	50	70	110	130	150	170
					8	24	40	56	H	72	88	h	104
					8	18	28	38	48	58	68	78	x
9	1	0	0	1	HT	31	)	51	71	111	131	151	171
					9	25	41	57	I	73	89	i	105
					9	19	29	39	49	59	69	79	y
10	1	0	1	0	LF	32	*	52	72	112	132	152	172
					10	26	42	58	J	74	90	j	106
					A	1A	2A	3A	4A	5A	6A	7A	z
11	1	0	1	1	VT	33	+	53	73	113	133	153	173
					11	27	43	59	K	75	91	k	107
					B	1B	2B	3B	4B	5B	6B	7B	o
12	1	1	0	0	FF	34	,	54	74	114	134	154	174
					12	28	44	60	L	76	92	l	108
					C	1C	2C	3C	4C	5C	6C	7C	n
13	1	1	0	1	CR	35	.	55	75	115	135	155	175
					13	29	45	61	M	77	93	m	109
					D	1D	2D	3D	4D	5D	6D	7D	c
14	1	1	1	0	SO	36	.	56	76	116	136	156	176
					14	30	46	62	N	78	94	n	110
					E	1E	2E	3E	4E	5E	6E	7E	~
15	1	1	1	1	SI	37	/	57	77	117	137	157	177
					15	31	47	63	O	79	95	o	111
					F	1F	2F	3F	4F	5F	6F	7F	DEL

KEY		
ASCII CHARACTERS	ESC	1/11
		33
		27
		18
		COLUMN ROW
		OCTAL
		DECIMAL
		HEX

HIGHLIGHTS DIFFERENCES FROM ASCII

Figure A-11: Digital Swedish Character Set

BITS					COLUMN		0	1	2	3	4	5	6	7	
B7	B6	B5					0	0	0	0	1	0	1	1	
ROW	B4	B3	B2	B1			0	1	0	1	0	1	0	1	
0	0	0	0	0	NUL	0	0	20	40	60	É	100	120	140	160
							0	16	32	48	84	80	96	112	112
							0	10	20	30	40	50	60	70	70
1	0	0	0	1	DC1 (XON)	1	1	21	41	61	101	121	141	161	161
							1	17	33	49	65	81	97	113	113
							1	11	21	31	41	51	61	71	71
2	0	0	1	0	DC3 (XOFF)	2	2	22	42	62	102	122	142	162	162
							2	18	34	50	66	82	98	114	114
							2	12	22	32	42	52	62	72	72
3	0	0	1	1	DC3 (XOFF)	3	3	23	43	63	103	123	143	163	163
							3	19	35	51	67	83	99	115	115
							3	13	23	33	43	53	63	73	73
4	0	1	0	0		4	4	24	44	64	104	124	144	164	164
							4	20	36	52	68	84	100	116	116
							4	14	24	34	44	54	64	74	74
5	0	1	0	1		5	5	25	45	65	105	125	145	165	165
							5	21	37	53	69	85	101	117	117
							5	15	25	35	45	55	65	75	75
6	0	1	1	0		6	6	26	46	66	106	126	146	166	166
							6	22	38	54	70	86	102	118	118
							6	16	26	36	46	56	66	76	76
7	0	1	1	1		7	7	27	47	67	107	127	147	167	167
							7	23	39	55	71	87	103	119	119
							7	17	27	37	47	57	67	77	77
8	1	0	0	0	BS	8	8	30	50	70	110	130	150	170	170
							8	24	40	56	72	88	104	120	120
							8	18	28	38	48	58	68	78	78
9	1	0	0	1	HT	9	9	31	51	71	111	131	151	171	171
							9	25	41	57	73	89	105	121	121
							9	19	29	39	49	59	69	79	79
10	1	0	1	0	LF	10	10	32	52	72	112	132	152	172	172
							A	26	42	58	74	90	106	122	122
							A	1A	2A	3A	4A	5A	6A	7A	7A
11	1	0	1	1	VT	11	11	33	53	73	113	133	153	173	173
							B	27	43	59	75	91	107	123	123
							B	1B	2B	3B	4B	5B	6B	7B	7B
12	1	1	0	0	FF	12	12	34	54	74	114	134	154	174	174
							C	28	44	60	76	92	108	124	124
							C	1C	2C	3C	4C	5C	6C	7C	7C
13	1	1	0	1	CR	13	13	35	55	75	115	135	155	175	175
							D	29	45	61	77	93	109	125	125
							D	1D	2D	3D	4D	5D	6D	7D	7D
14	1	1	1	0	SO	14	14	36	56	76	116	136	156	176	176
							E	30	46	62	78	94	110	126	126
							E	1E	2E	3E	4E	5E	6E	7E	7E
15	1	1	1	1	SI	15	15	37	57	77	117	137	157	177	177
							F	31	47	63	79	95	111	127	127
							F	1F	2F	3F	4F	5F	6F	7F	7F

KEY			
ASCII CHARACTERS	ESC	1/11	COLUMN ROW
		33	OCTAL
		27	DECIMAL
		1B	HEX
			HIGHLIGHTS DIFFERENCES FROM ASCII

RE UK00043M 89

Figure A-12: VT100 Special Graphics Character Set

BITS B7 B6 B5 ROW B4 B3 B2 B1					COLUMN 0 0		1	2	3	4	5	6	7
0	0	0	0	0	NUL	0	20	SP	0	@	P	♦	—
						0	16		40	64	80	96	SCAN 3
						0	10		20	40	50	60	112
1	0	0	0	1		1	21	!	41	61	101	121	161
						1	17		33	51	85	97	—
						1	11		21	31	41	61	SCAN 6
2	0	0	1	0		2	22	"	42	62	102	122	182
						2	18		34	50	86	98	—
						2	12		22	32	42	62	SCAN 7
3	0	0	1	1		3	23	#	43	63	103	123	183
						3	19		35	51	87	99	—
						3	13		23	33	43	63	SCAN 8
4	0	1	0	0		4	24	\$	44	64	104	124	184
						4	20		36	52	88	100	116
						4	14		24	34	44	64	74
5	0	1	0	1		5	25	%	45	65	105	125	165
						5	21		37	53	89	101	117
						5	15		25	35	45	65	75
6	0	1	1	0		6	26	&	46	66	106	126	186
						6	22		38	54	70	86	118
						6	16		26	36	46	66	76
7	0	1	1	1	BEL	7	27	'	47	67	107	127	187
						7	23		39	55	71	87	119
						7	17		27	37	47	67	77
8	1	0	0	0	BS	8	30	(	50	70	110	130	170
						8	24		40	56	72	88	120
						8	18		28	38	48	68	78
9	1	0	0	1	HT	9	31	)	51	71	111	131	171
						9	25		41	57	73	89	121
						9	19		29	39	49	69	79
10	1	0	1	0	LF	10	32	*	52	72	112	132	172
						A	26		42	58	74	90	122
						A	1A		2A	3A	4A	5A	7A
11	1	0	1	1	VT	11	33	+	53	73	113	133	173
						B	27		43	59	75	91	123
						B	1B		2B	3B	4B	5B	7B
12	1	1	0	0	FF	12	34	,	54	74	114	134	174
						C	28		44	60	76	92	124
						C	1C		2C	3C	4C	5C	7C
13	1	1	0	1	CR	13	35	-	55	75	115	135	175
						D	29		45	61	77	93	125
						D	1D		2D	3D	4D	5D	7D
14	1	1	1	0	SO	14	36	.	56	76	116	136	176
						E	30		46	62	78	94	126
						E	1E		2E	3E	4E	5E	7E
15	1	1	1	1	SI	15	37	/	57	77	117	137	177
						F	31		47	63	79	95	127
						F	1F		2F	3F	4F	5F	7F

KEY

ASCII CHARACTERS

ESC

1/11

COLUMN ROW

33

OCTAL

27

DECIMAL

18

HEX



HIGHLIGHTS DIFFERENCES
FROM ASCII

Figure A-13: Digital Technical Character Set

ROW	BITS				0		0		1		1		0		1		1					
	B8	B7	B6	B5	COLUMN	GL	GR	GL	GR	GL	GR	GL	GR	GL	GR	GL	GR					
	B4	B3	B2	B1		2	10		3		11		4		12		5	13	6	14	7	15
0	0	0	0	0			}	60 48 30	260 176 80	∴	100 64 40	300 192 C0	Π	120 80 50	320 208 D0	┘	140 96 60	340 224 E0	π	160 112 70	360 240 F0	
1	0	0	0	1	✓	41 33 21	241 161 A1	∠	61 49 31	261 177 81	∞	101 65 41	301 193 C1	Ψ	121 81 51	321 209 D1	α	141 97 61	341 225 E1	ψ	161 113 71	361 241 F1
2	0	0	1	0	┘	42 34 22	242 162 A2	∠	62 50 32	262 178 82	∞	102 66 42	302 194 C2	Σ	122 82 52	322 210 D2	β	142 98 62	342 226 E2	ρ	162 114 72	362 242 F2
3	0	0	1	1	—	43 35 23	243 163 A3	∠	63 51 33	263 179 83	+	103 67 43	303 195 C3	Σ	123 83 53	323 211 D3	χ	143 99 63	343 227 E3	σ	163 115 73	363 243 F3
4	0	1	0	0	┘	44 36 24	244 164 A4	/	64 52 34	264 180 84	Δ	104 68 44	304 196 C4		124 84 54	324 212 D4	δ	144 100 64	344 228 E4	τ	164 116 74	364 244 F4
5	0	1	0	1	J	45 37 25	245 165 A5	┘	65 53 35	265 181 85	∇	105 69 45	305 197 C5		125 85 55	325 213 D5	ε	145 101 65	345 229 E5		165 117 75	365 245 F5
6	0	1	1	0		46 38 26	246 166 A6	┘	66 54 36	266 182 86	Φ	106 70 46	306 198 C6	√	126 86 56	326 214 D6	φ	146 102 66	346 230 E6	f	166 118 76	366 246 F6
7	0	1	1	1	┘	47 39 27	247 167 A7	)	67 55 37	267 183 87	Γ	107 71 47	307 199 C7	Ω	127 87 57	327 215 D7	Υ	147 103 67	347 231 E7	ω	167 119 77	367 247 F7
8	1	0	0	0	L	50 40 28	270 168 A8		70 56 38	270 184 88	~	110 72 48	310 200 C8	Ξ	130 88 58	330 216 D8	η	150 104 68	350 232 E8	ξ	170 120 78	370 248 F8
9	1	0	0	1	┘	51 41 29	271 169 A9		71 57 39	271 185 89	=	111 73 49	311 201 C9	Υ	131 89 59	331 217 D9	ι	151 105 69	351 233 E9	υ	171 121 79	371 249 F9
10	1	0	1	0	J	52 42 2A	272 170 AA		72 58 3A	272 186 8A	Θ	112 74 4A	312 202 CA	⊂	132 90 5A	332 218 DA	θ	152 106 6A	352 234 EA	ζ	172 122 7A	372 250 FA
11	1	0	1	1	┘	53 43 2B	273 171 AB		73 59 3B	273 187 8B	×	113 75 4B	313 203 CB	⊃	133 91 5B	333 219 DB	κ	153 107 6B	353 235 EB	←	173 123 7B	373 251 FB
12	1	1	0	0	┘	54 44 2C	274 172 AC	≤	74 60 3C	274 188 8C	Λ	114 76 4C	314 204 CC	∩	134 92 5C	334 220 DC	λ	154 108 6C	354 236 EC	↑	174 124 7C	374 252 FC
13	1	1	0	1	┘	55 45 2D	275 173 AD	=	75 61 3D	275 189 8D	⇔	115 77 4D	315 205 CD	U	135 93 5D	335 221 DD		155 109 6D	355 237 ED	→	175 125 7D	375 253 FD
14	1	1	1	0	J	56 46 2E	276 174 AE	≥	76 62 3E	276 190 8E	⇒	116 78 4E	316 206 CE	^	136 94 5E	336 222 DE	v	156 110 6E	356 238 EE	↓	176 126 7E	376 254 FE
15	1	1	1	1	{	57 47 2F	277 175 AF	┘	77 63 3F	277 191 8F	≡	117 79 4F	317 207 CF	∨	137 95 5F	337 223 DF	∂	157 111 6F	357 239 EF			

LEGEND

CHARACTER

4/1	12/1
101	301
65	193
41	C1

COLUMN ROW

OCTAL

DECIMAL

HEX

* NOTE
WHEN SET IS MAPPED INTO GR
BIT B8 IS 1

Figure A-14: ISO Norwegian/Danish Character Set

BITS					COLUMN	0	1	2	3	4	5	6	7		
ROW	B4	B3	B2	B1	B7 0	0	0	0	0	1	1	1	1		
					B6 0	0	0	0	0	0	0	0			
0	0	0	0	0	NUL	0	20	SP	40	80	100	120	140	160	
1	0	0	0	1	DC1 (XON)	0	16	!	32	0	48	64	80	96	112
						1	21	41	61	101	121	141	161		
						2	17	33	49	65	81	97	113		
2	0	0	1	DC3 (XOFF)	1	11	"	21	1	31	41	51	61	71	
					2	22	42	62	102	122	142	162			
					3	18	34	50	66	82	98	114			
3	0	0	1	DC3 (XOFF)	2	12	#	22	2	32	42	52	62	72	
					3	23	43	63	103	123	143	163			
					4	19	35	51	67	83	99	115			
4	0	1	0	DC3 (XOFF)	3	13	\$	23	3	33	43	53	63	73	
					4	24	44	64	104	124	144	164			
					5	20	36	52	68	84	100	116			
5	0	1	0	DC3 (XOFF)	4	14	%	24	4	44	54	64	74		
					5	25	45	65	105	125	145	165			
					6	21	37	53	69	85	101	117			
6	0	1	0	DC3 (XOFF)	5	15	&	25	5	35	45	55	65	75	
					6	26	46	66	106	126	146	166			
					7	22	38	54	70	86	102	118			
7	0	1	1	DC3 (XOFF)	6	16	'	26	6	36	46	56	66	76	
					7	27	47	67	107	127	147	167			
					8	23	39	55	71	87	103	119			
8	1	0	0	CAN	7	17	(	27	7	37	47	57	67	77	
					8	30	50	70	110	130	150	170			
					9	24	40	56	72	88	104	120			
9	1	0	0	CAN	9	18	)	28	8	38	48	58	68	78	
					10	31	51	71	111	131	151	171			
					11	25	41	57	73	89	105	121			
10	1	0	0	SUB	12	19	*	29	9	39	49	59	69	79	
					13	32	52	72	112	132	152	172			
					14	26	42	58	74	90	106	122			
11	1	0	1	ESC	1A	1A	:	2A	J	4A	5A	6A	7A		
					13	33	53	73	113	133	153	173			
					14	27	43	59	75	91	107	123			
12	1	1	0	ESC	1B	1B	+	2B	K	4B	5B	6B	7B		
					15	34	54	74	114	134	154	174			
					16	28	44	60	76	92	108	124			
13	1	1	0	FF	1C	1C	,	2C	L	4C	5C	6C	7C		
					15	35	55	75	115	135	155	175			
					16	29	45	61	77	93	109	125			
14	1	1	0	CR	1D	1D	-	2D	M	4D	5D	6D	7D		
					17	36	56	76	116	136	156	176			
					18	30	46	62	78	94	110	126			
15	1	1	1	SO	1E	1E	.	2E	N	4E	5E	6E	7E		
					17	37	57	77	117	137	157	177			
					18	31	47	63	79	95	111	127			
15	1	1	1	SI	1F	1F	/	2F	O	4F	5F	6F	7F		
					19	38	58	78	118	138	158	178			

KEY		COLUMN ROW	
ASCII CHARACTERS	ESC	1/11	
		33	OCTAL
		27	DECIMAL
		1B	HEX

 HIGHLIGHTS DIFFERENCES FROM ASCII

Figure A-15: Digital Dutch Character Set

BITS B7 B6 B5 ROW B4 B3 B2 B1					COLUMN 0 0 0		1 0 0	2 0 1	3 0 1	4 1 0	5 1 0	6 1 1	7 1 1
0	0	0	0	0	NUL	0	20	SP	0	60	100	120	140
						0	16		40	48	64	80	96
						0	10		20	30	40	50	60
1	0	0	0	1		1	21	!	1	61	101	121	141
						1	17		49	65	81	97	113
						1	11		31	41	51	61	71
2	0	0	1	0		2	22	"	2	62	102	122	142
						2	18		50	66	82	98	114
						2	12		32	42	52	62	72
3	0	0	1	1		3	23	£	3	63	103	123	143
						3	19		51	67	83	99	115
						3	13		33	43	53	63	73
4	0	1	0	0		4	24	\$	4	64	104	124	144
						4	20		52	68	84	100	116
						4	14		34	44	54	64	74
5	0	1	0	1		5	25	%	5	65	105	125	145
						5	21		53	69	85	101	117
						5	15		35	45	55	65	75
6	0	1	1	0		6	26	&	6	66	106	126	146
						6	22		54	70	86	102	118
						6	16		36	46	56	66	76
7	0	1	1	1		7	27	'	7	67	107	127	147
						7	23		55	71	87	103	119
						7	17		37	47	57	67	77
8	1	0	0	0	BS	8	30	(	8	70	110	130	150
						8	24		56	72	88	104	120
						8	18		38	48	58	68	78
9	1	0	0	1	HT	9	31	)	9	71	111	131	151
						9	25		57	73	89	105	121
						9	19		39	49	59	69	79
10	1	0	1	0	LF	10	32	*	10	72	112	132	152
						10	26		58	74	90	106	122
						10	1A		3A	4A	5A	6A	7A
11	1	0	1	1	VT	11	33	+	11	73	113	133	153
						11	27		59	75	91	107	123
						11	1B		3B	4B	5B	6B	7B
12	1	1	0	0	FF	12	34	,	12	74	114	134	154
						12	28		60	76	92	108	124
						12	1C		3C	4C	5C	6C	7C
13	1	1	0	1	CR	13	35	-	13	75	115	135	155
						13	29		61	77	93	109	125
						13	1D		3D	4D	5D	6D	7D
14	1	1	1	0	SO	14	36	.	14	76	116	136	156
						14	30		62	78	94	110	126
						14	1E		3E	4E	5E	6E	7E
15	1	1	1	1	SI	15	37	/	15	77	117	137	157
						15	31		63	79	95	111	127
						15	1F		3F	4F	5F	6F	7F

KEY

ASCII CHARACTERS

ESC

1/11

COLUMN ROW

OCTAL

DECIMAL

HEX

HIGHLIGHTS DIFFERENCES FROM ASCII

NOTE

THE FOLLOWING TABLE INDICATE THE APPROXIMATION THAT ARE USE TO REPRESENT THE DUTCH CHARACTER THAT ARE NOT AVAILABLE IN THE DECMCS SET (THESE APPROXIMATIONS ARE TO BE COMPATIBLE WITH THE VT220 AND VT240) THE CHARACTER POSITION IN THE CHART IS LISTED BY COLUMN/ROW

COLUMN/

ROW

CHARACTER SET

NAME (SYMBOL)

THREE QUARTERS (3/4)

LOWER CASE ij LIGATURE (ij)

DIAERESIS (¨)

FLORIN SIGN (f)

ACUTE ACCENT (´)

APPROXIMATION

NAME (SYMBOL)

SUPERSCRIP (ª)

LOWER CASE y WITH DIAERESIS (ÿ)

QUOTATION MARKS (")

LOWER CASE i (ï)

APOSTROPHE, SINGLE QUOTATION MARK, ASCII ACUTE ACCENT (´)

RE UK00831M 88

Figure A-16: Digital Swiss Character Set

BITS				COLUMN		1	2	3	4	5	6	7	
87	96	85		0	0	0	0	0	1	1	1	1	
ROW	84	83	82	81									
0	0	0	0	0	NUL	0	20	40	60	100	120	140	160
						0	16	32	48	64	80	96	112
						0	10	20	30	40	50	60	70
1	0	0	0	1		1	21	41	61	101	121	141	161
					DC1	1	17	33	49	65	81	97	113
					(XON)	1	11	21	31	41	51	61	71
2	0	0	1	0		2	22	42	62	102	122	142	162
						2	18	34	50	66	82	98	114
						2	12	22	32	42	52	62	72
3	0	0	1	1		3	23	43	63	103	123	143	163
					DC3	3	19	35	51	67	83	99	115
					(XOFF)	3	13	23	33	43	53	63	73
4	0	1	0	0		4	24	44	64	104	124	144	164
						4	20	36	52	68	84	100	116
						4	14	24	34	44	54	64	74
5	0	1	0	1		5	25	45	65	105	125	145	165
						5	21	37	53	69	85	101	117
						5	15	25	35	45	55	65	75
6	0	1	1	0		6	26	46	66	106	126	146	166
						6	22	38	54	70	86	102	118
						6	16	26	36	46	56	66	76
7	0	1	1	1		7	27	47	67	107	127	147	167
						7	23	39	55	71	87	103	119
						7	17	27	37	47	57	67	77
8	1	0	0	0	BS	10	30	50	70	110	130	150	170
					CAN	8	24	40	56	72	88	104	120
						8	18	28	38	48	58	68	78
9	1	0	0	1	HT	11	31	51	71	111	131	151	171
						9	25	41	57	73	89	105	121
						9	19	29	39	49	59	69	79
10	1	0	1	0	LF	12	32	52	72	112	132	152	172
					SUB	10	26	42	58	74	90	106	122
						10	1A	2A	3A	4A	5A	6A	7A
11	1	0	1	1	VT	13	33	53	73	113	133	153	173
					ESC	11	27	43	59	75	91	107	123
						11	1B	2B	3B	4B	5B	6B	7B
12	1	1	0	0	FF	14	34	54	74	114	134	154	174
						12	28	44	60	76	92	108	124
						12	1C	2C	3C	4C	5C	6C	7C
13	1	1	0	1	CR	15	35	55	75	115	135	155	175
						13	29	45	61	77	93	109	125
						13	1D	2D	3D	4D	5D	6D	7D
14	1	1	1	0	SO	16	36	56	76	116	136	156	176
						14	30	46	62	78	94	110	126
						14	1E	2E	3E	4E	5E	6E	7E
15	1	1	1	1	SI	17	37	57	77	117	137	157	177
						15	31	47	63	79	95	111	127
						15	1F	2F	3F	4F	5F	6F	7F

KEY

ASCII CHARACTERS

ESC

1/11

COLUMN ROW

33

OCTAL

27

DECIMAL

16

HEX



HIGHLIGHTS DIFFERENCES
FROM ASCII

NOTE:

AT COLUMN/ROW 5/15 LOWERCASE **o** WITH GRAVE ACCENT
REPLACES UNDERLINE (**_**) WHICH IS USED IN ASCII AND ALL
OTHER NRC SETS.

RE UK00844M B6

Figure A-17: Digital Portuguese Character Set

BITS				COLUMN		0	1	2	3	4	5	6	7
B7 B6 B5				0		0	0		0	1	0	1	1
ROW B4 B3 B2 B1				0	0	1	1	0	1	0	1	0	1
0	0	0	0	0	0	0	0	0	0	0	0	0	0
1	0	0	0	1	1	1	1	1	1	1	1	1	1
2	0	0	1	0	0	0	0	0	0	0	0	0	0
3	0	0	1	1	1	1	1	1	1	1	1	1	1
4	0	1	0	0	0	0	0	0	0	0	0	0	0
5	0	1	0	1	1	1	1	1	1	1	1	1	1
6	0	1	1	0	0	0	0	0	0	0	0	0	0
7	0	1	1	1	1	1	1	1	1	1	1	1	1
8	1	0	0	0	0	0	0	0	0	0	0	0	0
9	1	0	0	1	1	1	1	1	1	1	1	1	1
10	1	0	1	0	0	0	0	0	0	0	0	0	0
11	1	0	1	1	1	1	1	1	1	1	1	1	1
12	1	1	0	0	0	0	0	0	0	0	0	0	0
13	1	1	0	1	1	1	1	1	1	1	1	1	1
14	1	1	1	0	0	0	0	0	0	0	0	0	0
15	1	1	1	1	1	1	1	1	1	1	1	1	1

NUL	0	20	40	60	80	100	120	140	160
	0	16	32	48	64	80	96	112	128
	0	10	20	30	40	50	60	70	80
	1	21	41	61	81	101	121	141	161
	1	17	33	49	65	81	97	113	129
	1	11	21	31	41	51	61	71	81
	2	22	42	62	82	102	122	142	162
	2	18	34	50	66	82	98	114	130
	2	12	22	32	42	52	62	72	82
	3	23	43	63	83	103	123	143	163
	3	19	35	51	67	83	99	115	131
	3	13	23	33	43	53	63	73	83
	4	24	44	64	84	104	124	144	164
	4	20	36	52	68	84	100	116	132
	4	14	24	34	44	54	64	74	84
	5	25	45	65	85	105	125	145	165
	5	21	37	53	69	85	101	117	133
	5	15	25	35	45	55	65	75	85
	6	26	46	66	86	106	126	146	166
	6	22	38	54	70	86	102	118	134
	6	16	26	36	46	56	66	76	86
	7	27	47	67	87	107	127	147	167
	7	23	39	55	71	87	103	119	135
	7	17	27	37	47	57	67	77	87
	8	30	50	70	90	110	130	150	170
	8	24	40	56	72	88	104	120	136
	8	18	28	38	48	58	68	78	88
	9	31	51	71	91	111	131	151	171
	9	25	41	57	73	89	105	121	137
	9	19	29	39	49	59	69	79	89
	10	32	52	72	92	112	132	152	172
	10	26	42	58	74	90	106	122	138
	10	20	30	40	50	60	70	80	90
	11	33	53	73	93	113	133	153	173
	11	27	43	59	75	91	107	123	139
	11	21	33	43	53	63	73	83	93
	12	34	54	74	94	114	134	154	174
	12	28	44	60	76	92	108	124	140
	12	22	34	44	54	64	74	84	94
	13	35	55	75	95	115	135	155	175
	13	29	45	61	77	93	109	125	141
	13	23	35	45	55	65	75	85	95
	14	36	56	76	96	116	136	156	176
	14	30	46	62	78	94	110	126	142
	14	24	36	46	56	66	76	86	96
	15	37	57	77	97	117	137	157	177
	15	31	47	63	79	95	111	127	143
	15	25	37	47	57	67	77	87	97

KEY

ASCII CHARACTERS

ESC

1/11

33

27

18

COLUMN ROW

OCTAL

DECIMAL

HEX

Figure A-18: Digital Supplemental Character Set

BITS				COLUMN		0	1	2	3	4	5	6	7
B7	B6	B5		0	0	0	0	0	0	1	1	1	1
ROW	B4	B3	B2	B1	0	0	0	0	0	0	0	0	0
0	0	0	0	0	NUL	0	20	40	60	80	100	120	140
						0	16	32	48	64	80	96	112
						0	10	20	30	40	50	60	70
1	0	0	0	1		1	21	41	61	81	101	121	141
						1	17	33	49	65	81	97	113
						1	11	21	31	41	51	61	71
2	0	0	1	0		2	22	42	62	82	102	122	142
						2	18	34	50	66	82	98	114
						2	12	22	32	42	52	62	72
3	0	0	1	1		3	23	43	63	83	103	123	143
						3	19	35	51	67	83	99	115
						3	13	23	33	43	53	63	73
4	0	1	0	0		4	24	44	64	84	104	124	144
						4	20	36	52	68	84	100	116
						4	14	24	34	44	54	64	74
5	0	1	0	1		5	25	45	65	85	105	125	145
						5	21	37	53	69	85	101	117
						5	15	25	35	45	55	65	75
6	0	1	1	0		6	26	46	66	86	106	126	146
						6	22	38	54	70	86	102	118
						6	16	26	36	46	56	66	76
7	0	1	1	1		7	27	47	67	87	107	127	147
						7	23	39	55	71	87	103	119
						7	17	27	37	47	57	67	77
8	1	0	0	0	BS	10	30	50	70	90	110	130	150
						8	24	40	56	72	88	104	120
						8	18	28	38	48	58	68	78
9	1	0	0	1	HT	11	31	51	71	91	111	131	151
						9	25	41	57	73	89	105	121
						9	19	29	39	49	59	69	79
10	1	0	1	0	LF	12	32	52	72	92	112	132	152
						10	26	42	58	74	90	106	122
						10	1A	2A	3A	4A	5A	6A	7A
11	1	0	1	1	VT	13	33	53	73	93	113	133	153
						11	27	43	59	75	91	107	123
						11	1B	2B	3B	4B	5B	6B	7B
12	1	1	0	0	FF	14	34	54	74	94	114	134	154
						12	28	44	60	76	92	108	124
						12	1C	2C	3C	4C	5C	6C	7C
13	1	1	0	1	CR	15	35	55	75	95	115	135	155
						13	29	45	61	77	93	109	125
						13	1D	2D	3D	4D	5D	6D	7D
14	1	1	1	0	SO	16	36	56	76	96	116	136	156
						14	30	46	62	78	94	110	126
						14	1E	2E	3E	4E	5E	6E	7E
15	1	1	1	1	SI	17	37	57	77	97	117	137	157
						15	31	47	63	79	95	111	127
						15	1F	2F	3F	4F	5F	6F	7F

KEY

ASCII CHARACTERS

ESC	111
	33
	27
	18

COLUMN ROW

OCTAL
DECIMAL
HEX

SUPPLEMENTAL GRAPHIC SET

RE. UK00847M.86

Appendix B

CONTROL CODE AND CONTROL SEQUENCE SUMMARY

Table B-1 lists the 7-bit control characters, Table B-2 lists the 8-bit control characters, and Table B-3 lists the escape and control sequences. The section cross-references in all three tables refer to the *LG31 User's Guide*.

B.1 The 7-Bit Control Characters

Table B-1: The 7-Bit Control Characters

Control Characters	Description	Section
<BEL>	Sounds Buzzer	4.5.1.1
<HT>	Horizontal Tab	4.5.1.3
<LF>	Line Feed	4.5.1.4
<FF>	Form Feed	4.5.1.6
<CR>	Carriage Return	4.5.1.7
<SO>	Shift Out	4.5.1.8
<SI>	Shift In	4.5.1.9
<ESC>	Escape	4.5.1.14
<BS>	Backspace	4.5.1.2
<VT>	Vertical Tab	4.5.1.5
<DC1>	Device Control 1/XON	4.5.1.10
<DC3>	Device Control 3/XOFF	4.5.1.11
<CAN>	CANcel	4.5.1.12
<SUB>	SUBstitute	4.5.1.13

B.2 The 8-Bit Control Characters

Table B-2: 8-Bit Control Characters

Control Characters	Description	Section
<IND>	Forward index	4.5.2.1
<RI>	Reverse Index	4.5.2.2
<HTS>	Horizontal Tab Set	4.5.2.3
<VTS>	Vertical Tab Set	4.5.2.4
<PLD>	Partial Line Down	4.5.2.5
<PLU>	Partial Line Up	4.5.2.6
<NEL>	Next Line	4.5.2.7
<SS2>	Single Shift 2	4.5.2.8
<SS3>	Single Shift 3	4.5.2.9
<DCS>	Device Control String Introducer	4.5.2.11
<CSI>	Control String Introducer	4.5.2.11
<ST>	String Terminator	4.5.2.12
<OCS>	Operating System Command	4.5.2.13
<PM>	Privacy Message	4.5.2.13
<APC>	Application Program Command	4.5.2.13

B.3 The LG31 Escape and Control Sequences

The escape and control sequences are shown in 8-bit format. Sequence characters are spaced for clarity. The spaces are not part of the format code. The row/column number below each character indicates the character's position in the 8-bit DEC Multinational character set.

Table B-3: LG31 Escape and Control Sequences

Name	Mnemonic	Sequence
Forward Index (5.4.7.1)	IND	IND 8/4 Moves the active position to the same horizontal position on the next line
Horizontal Tab Stop (5.4.8.1)	HTS	HTS 8/8 Sets a horizontal tab stop at the active column
Reverse Index Set (4.5.2.2)	RI	RI 8/13 Moves the active horizontal position to the previous line
Partial Line Down (5.4.7.11)	PLD	PLD 8/11 Moves the vertical position 3/72 in down
Partial Line Up (5.4.7.12)	PLU	PLU 8/12 Moves the vertical position 3/72 in up
Tabulator Clear (5.4.8.5)	TBC	CSI Pn g 9/11 *** 6/7 Clears one or more horizontal or vertical tab stops
VFU Channel Command (5.4.10.3)	VFU	CSI nnn & y 9/11 *** 2/6 7/9 Allows access to a previously loaded VFU table through channel nnn
Cursor Up (5.4.7.10)	CUU	CSI Pn A 9/11 *** 4/1 Moves the vertical position Pn times up, retaining column position

Table B-3 (Cont.): LG31 Escape and Control Sequences

Name	Mnemonic	Sequence
VFU End Command (5.4.10.2)	VFU	CSI < I 1 9/11 3/12 3/1 6/12 Sends to indicate that the printer that the VFU table loaded is complete
VFU Load (5.4.10.1)	VFU	CSI < 1 h 9/11 3/12 3/1 6/8 Prepares the printer for loading the 1L channel VFU table
Autowrap Mode (5.4.9.1)	DECAWM	CSI ? 7 h 9/11 3/15 3/7 6/8 Turns autowrap mode on. CSI ? 7 1 9/11 3/15 3/7 6/12 Turns autowrap mode off.
Barcode Encoding (8.3.2, 8.3.3)	DECBAR	CSI % SP 0 9/11 2/5 2/0 3/0 Starts the bar code sequence. ESC 1/11 Stops the barcode sequence.
Barcode Select (8.3.1)	DECSBCA	CSI P1 ; ... ; P3 , q 9/11 *** 3/11 ... 3/11 *** 2/7 7/1 Defines parameters for barcodes that are to be printed. P# Function P1 Type of encoding 0 = Default value (Code 39) 1 = Interleaved Two of Five 2 = Code 39 3 = Extended Code 39 P2 Width of narrow bars and spaces 0/missing = default value P3 Width of quiet zone 0/missing = default value

Table B-3 (Cont.): LG31 Escape and Control Sequences

Name	Mnemonic	Sequence
		P4 Width of wide bars and spaces 0/missing = default value P5 Gap between characters 0/missing = default value P6 Height of bars 0/missing = default value P7 Control-character encoding character 0 = no encoding of control characters n = the decimal ASCII value of the character P8 Orientation 0 = Same as current page 1 = Horizontal (portrait) 2 = Vertical, rotation of -90(landscape) 3 = Vertical, rotation of +90 (landscape) 4 = Horizontal, upside down, rotation of 180 Other values = disregard sequence Missing = Default value P9 Characters option 0 = Default 1 = No Characters 2 = Characters in currently selected plot font 3 = Characters in OCR A 4 = Characters in OCR B Other = Disregard sequence Missing = Default value
Block Character Entering (8.4.2 8.4.4)	DECBCM	ESC % SP 1 1/11 2/5 2/0 3/1 Starts the block character sequence. ESC @ 1/11 4/0 % 2/5 Stops the block character sequence.

NOTE

This stop sequence is also used to stop barcodes.

Block Character	DECBCS	CSI	P1	;	P5	'	r
		9/11	***	3/11	***	2/7	7/2

Table B-3 (Cont.): LG31 Escape and Control Sequences

Name	Mnemonic	Sequence
Size Select (8.4.1)		Defines the parameters for block characters. P1 specifies the width of the block characters. P2 specifies the height of the block characters. P3 specifies the color of background. P4 specifies the international character set designator. P5 specifies the orientation of the block characters.
Bold Printing (5.4.3)	SGR	CSI P_s m 9/11 *** 6/13 Turns the bold printing on or off. P_s Function 0 All attributes off 1 Turns bold on 22 Turns bold off
Device Attribute (Product ID) (5.9)	DA	Requests device's product ID from host (only) through serial port. CSI c or CSI 0 c 9/11 6/3 9/11 3/0 6/3 Printer ID response, which is dependent upon strap setting: CSI ? 4 2 c (LG31) 9/11 3/15 3/4 3/2 6/3 CSI ? 3 6 c (LG01) 9/11 3/15 3/3 3/6 6/3
Device Status Request (from host) (6.3.1)	DSR	CSI n or CSI 0 n 9/11 6/14 9/11 3/0 6/14 Send extended report. CSI 6 n 9/11 3/6 6/14 Send the cursor position report (active column and active line). CSI ? 1 n 9/11 3/15 3/1 6/14 Disable unsolicited reports.

Table B-3 (Cont.): LG31 Escape and Control Sequences

Name	Mnemonic	Sequence
		CSI ? 2 n 9/11 3/15 3/2 6/14 Enable brief unsolicited reports and send extended report.
		CSI ? 3 n 9/11 3/15 3/3 6/14 Enable extended unsolicited reports and send extended report.
Device	DSR	Brief Report:
Status		CSI 0 n
Report		9/11 3/0 6/14
(from printer)		No malfunction detected
(6.3.2)		CSI 3 n 9/11 3/3 6/14 Malfunction detected.
		Extended Report:
		CSI 0 n
		9/11 3/0 6/14
		followed by
		CSI ? 2 0 n
		9/11 3/15 3/2 3/0 6/14
		No malfunction detected.
		CSI 3 n
		9/11 3/3 6/14
		followed by
		CSI ? Pn ; ... Pn n
		9/11 3/15 *** 3/11 ... *** 6/14
		Malfunction detected.
		Pn Function
		20 to 215 Error code (Table 5-9)
		Cursor status report:
		CSI Pn1 ; Pn2 R
		9/11 *** 3/11 *** 5/2
		Pn1 is the active line.
		Pn2 is the active column.

Table B-3 (Cont.): LG31 Escape and Control Sequences

Name	Mnemonic	Sequence						
Draw Vector (8.2.1)	DECVEC	CSI	Pn1	;	...	Pn5	!	
		9/11	***	3/11	...	***	2/1	7/12
		Draw a line with length, width, and direction.						
		Pn1	Function					
		0	Draw x line, horizontal					
		1	Draw y line, vertical					
		Pn2	= x start position					
		Pn3	= y start position					
		Pn4	= line length					
		Pn5	= line width					
		Pn2 through Pn5 are in character, decipoint, or pixel units (selected by SSU sequence). The default value of each parameter is 0.						
Graphic Size Modification (5.4.4)	GSM	CSI	Pn1	;	Pn2	SP	B	
		9/11	***	3/11	***	2/0	4/2	
		Modify font height and width set by GSS sequence.						
		Pn1	=	decimal percentage of height set by GSS. Default value is 100.				
		Pn2	=	decimal percentage of width set by GSS. Default value is 100.				
Horizontal Pitch (5.4.5.1)	DECSHORP	CSI	Ps	w				
		9/11	***	7/7				
		Selects horizontal pitch (characters/inch). Controlled by DECPSM.						
		Ps	Horizontal Pitch					
		0	Determined by current font (default)					
		1	10					
		2	12					
		3	13.3					
		4	16.7					
		5	5					
		6	6					
		7	6.67					
		8	8.35					
		9	15					

Table B-3 (Cont.): LG31 Escape and Control Sequences

Name	Mnemonic	Sequence
Horizontal Position Absolute (5.4.7.4)	HPA	CSI Pn ' 6/0 Selects the active column on current active vertical line. Pn = numeric value in character, decipoint, or pixel units (selected by SSU sequence). Default value = 1.
Horizontal Position Relative (5.4.7.5)	HPR	CSI Pn a 6/1 Adds Pn to the current active column. Pn = numeric value in character, decipoint or pixel units (selected by SSU sequence). Default value = 1.
Horizontal Position Backward (5.4.7.6)	HPB	CSI Pn j 6/10 Subtracts Pn from current active column. Pn = numeric value in character, decipoint or pixel units (selected by SSU sequence). Default value = 1.
Horizontal Tabs, Set (5.4.8.2)	DECSHTS	CSI Pn ; ... ; Pn u 9/11 *** 3/11 ... 3/11 *** 7/5 Sets up to 32 horizontal tabs (16 horizontal tabs at one time). Pn = tab stop in character, decipoint, or pixel units (selected by SSU sequence).
Italic Printing (5.4.3)	SGR	CSI Ps m 9/11 *** 6/13 Selects italic print if font file has italic attribute. Ps Function 0 All attributes off 3 Italic printing on 23 Italic printing off
Margins, Left and Right (4.5.6.3)	DECSLRM	CSI Pn1 ; Pn2 s 9/11 *** 3/11 *** 7/3 Sets left and right margins in character, deci-point, or pixel units (selected by SSU sequence). Pn1 = left margin and line home setting Pn2 = right margin setting

Table B-3 (Cont.): LG31 Escape and Control Sequences

Name	Mnemonic	Sequence
Margins, Top and Bottom (5.4.6.2)	DECSTBM	CSI Pn1 ; Pn2 r 9/11 *** 3/11 *** 7/2 Sets top and bottom margins in character, deci-point, or or pixel units (selected by SSU sequence). Pn1 = top margin and page home setting Pn2 = bottom margin setting
Reset to Initial State (5.13)	RIS	ESC c 1/11 6/3 Resets the printer's operating features to initial values.
Select Font (5.4.3)	SGR	CSI Ps m 9/11 *** 6/13 Selects a font for printing. Ps Function 10 Primary font (default) 11 First alternate font . . 19 Ninth alternate font
Sixel Graphics Sending (7.3)	DCS	DCS Ps1 ; Ps3 q SD ST 9/0 *** 3/11 *** 7/1 ***** 9/12 Ps1 Function 0 - 9 Select standard horizontal grid size Ps2 Function n Select a background color - ignored Ps3 Function 0 - 9 Select horizontal grid size other than standard sizes SD= Printable data and control characters Sixel data
Soft Terminal Reset (6.4.2)	DECSTR	CSI ! p 9/11 2/1 7/0 Resets the printer's operating features to the initial values.

Table B-3 (Cont.): LG31 Escape and Control Sequences

Name	Mnemonic	Sequence		
Tabs, Setting		See horizontal tabs (DECSHTS) and vertical (DECSVTS) tabs.		
Tabs, Clearing (5.4.8.5)	TBC	CSI 9/11	P# ***	g 6/7
		Clears horizontal or vertical tabs.		
		P#	Function	
		0	Clears one horizontal tab at active column.	
		1	Clears one vertical tab at active line.	
		2	Clears all horizontal tabs.	
		3	Clears all horizontal tabs.	
		4	Clears all vertical tabs.	
Vertical Pitch (5.4.5.2)	DECVERP	CSI 9/11	P# ***	z 7/10
		Selects the vertical pitch (lines-per-inch).		
		P#	Pitch	
		0	Determined by current font (default)	
		1	6	
		2	8	
		3	12	
		4	2	
		5	3	
		6	4	
		7	10	
Vertical Position Absolute (5.4.7.7)	VPA	CSI 9/11	Pn ***	d 6/4
		Selects vertical line without changing the active column.		
		Pn	=	new active line, in character, decipoint, or pixel units (selected by SSU sequence). Default value = 1.
Vertical Position Backward (5.4.7.9)	VPB	CSI 9/11	Pn ***	k 6/11
		Subtracts Pn from active vertical line.		
		Pn	=	value in character, decipoint, or pixel units (selected by SSU sequence). Default value = 1.

Table B-3 (Cont.): LG31 Escape and Control Sequences

Name	Mnemonic	Sequence
Vertical Position Relative (5.4.7.5)	VPR	CSI Pn e 9/11 *** 6/5 Adds Pn to active vertical line. Pn = value in character, decipoint, or pixel units (selected by SSU sequence). Default value = 1.
Vertical Tabs, Set (5.4.8.4)	DECSVTS	CSI Pn ; ... ; Pn v 9/11 *** 3/11 ... 3/11 *** 7/6 Sets up to 16 vertical tabs at one time (67 available vertical tab positions). Pn = vertical tab stop in character, decipoint, or pixel units (selected by SSU sequence).
Vertical Tab Stop (5.4.8.3)	VTs	<VTs> 8A Sets a vertical tab stop at the active line

Appendix C

FACTORY, POWER-UP, AND RESET DEFAULTS

These tables list the LG31 factory settings, power-up defaults, power-up reset conditions, and reset defaults.

Table C-1: Factory Settings at Initial Power-Up

Parameter	Control Function	Factory Setting
Printer Status		Off line
Horizontal Pitch	(DECSHORP)	10 Characters-Per-Inch (CPI)
Vertical Pitch	(DECVERP)	6 Lines-Per-Inch (LPI)
Font	(SGR)	Data Processing
Forms Length	(DECSLPP)	66 Lines (11 in/27.94 cm)
Active Position	Column 1 on the active line (line 1)	
Top Margin	Line 1	
Bottom Margin	Line 66	
Left Margin	Column 1	
Right Margin	Column 132	
Underlining	(SGR)	Disabled
Bolding	(SGR)	Disabled
Italics	(SGR)	Disabled
Character Expansion	(SGR)	Disabled
GL Character Set		U.S. ASCII

Table C-1 (Cont.): Factory Settings at Initial Power-Up

Parameter	Control Function	Factory Setting
GR Character Set	(DECAWM)	Digital Supplemental
G0 Character Set		U.S. ASCII
G1 Character Set		VT100 Graphic Character Set
G2 Character Set		Digital Supplemental
G3 Character Set		U.S. ASCII
Autowrap		Enabled
Line Feed/New Line Mode		Set
Horizontal Tabs		Set every 8 columns (9, 17, ... 137)
Unsolicited Reports		Disabled
Super/Subscripts		Disabled
Carriage Return		Reset
New Line Mode		Reset
Vertical Tabs		Every Line (1, 2, ... 66)
Number of Data Bits		8-bit mode
Number of Stop Bits		1 stop bit
Speed (Baud Rate)		9600 Baud
Parity		Disabled

Table C-2: Power-Up Conditions Retained from Last Work Session

Parameter	Control Function
Horizontal Pitch	(DECSHORP)
Vertical Pitch	(DECVERP)
Font	(SGR)
Top of Form	
Form's Length	(DECSLPP)
Top and Bottom Margin	(DECSTBM)
Left and Right Margin	(DECSLRM)
Autowrap	(DECAWM)
Line Feed/New Line	(LNM)
Carriage Return/ New Line Mode	(DECCRNLM)
Horizontal Tabs	
Vertical Tabs	
GL Character Set	
GR Character Set	
G0 Character Set	
G1 Character Set	
G2 Character Set	
G3 Character Set	
All Interface Settings	

Table C-3: Power-Up Conditions Reset at the Start of New Work Session

Selectable Parameter	Control Function	Power-Up Condition
Printing Status		Off Line
Active Position		Column 1 on current active line
Underlining	(SGR)	Disabled
Bolding	(SGR)	Disabled
Expansion	(SGR)	Disabled
Unsolicited Reports		Disabled
Super/Subscripts		Disabled

Table C-4: Default Settings After Receipt of a Reset

Parameter	Control Function	Factory Setting Default
Printing Status		On Line (Ready)
Horizontal Pitch	(DECHORP)	10 Characters-Per-Inch (CPI)
Vertical Pitch	(DECSVERP)	6 Lines-Per-Inch (LPI)
Font	(SGR)	Data Processing
Forms Length	(DECSLPP)	66 Lines (11 in/27.94 cm)
Active Position		Column 1 on the current active
Top Margin		Line 1
Bottom Margin		Line 66
Left Margin		Column 1
Right Margin		Column 132
Underlining	(SGR)	Disabled
Bolding	(SGR)	Disabled
Italics	(SGR)	Disabled
Expansion	(GSM)	Disabled
GL Character Set		U.S. ASCII or the last NRC if selected
GR Character Set		Digital Supplemental
G0 Character Set		U.S. ASCII or the last NRC if selected
G1 Character Set		VT100 Graphic Character Set
G2 Character Set		Digital Supplemental
G3 Character Set		U.S. ASCII
Autowrap		Enabled
Line Feed/New Line Mode		Set
Horizontal Tabs		Set every 8 columns (9, 17,...137)
Unsolicited Reports	(DSR)	Disabled
Super/Subscripts		Disabled
Carriage Return		Reset
New Line Mode		Reset
Vertical Tabs		Every Line (1, 2, ... 66)
The following will not change:		
All interface settings		
The National Replacement Character Set		
These parameters will remain as previously selected, either by escape sequence or control panel.		

[illegible][illegible]

Appendix D

VFU CROSS REFERENCE TABLE

Table D-1 provides a cross reference between the VFU Table byte pair bit patterns and the equivalent characters (CHAR), decimal (DEC) values, and hexadecimal (Hex) values.

Table D-1: VFU Table Cross Reference

Char	DEC	Hex	Bit Pattern 12345678	Char	DEC	Hex	Bit Pattern 12345678
@	64	40	0000001x	'	96	60	0000011x
A	65	41	1000001x	a	97	61	1000011x
B	66	42	0100001x	b	98	62	0100011x
C	67	43	1100001x	c	99	63	1100011x
D	68	44	0010001x	d	100	64	0010011x
E	69	45	1010001x	e	101	65	1010011x
F	70	46	0110001x	f	102	66	0110011x
G	71	47	1110001x	g	103	67	1110011x
H	72	48	0001001x	h	104	68	0001011x
I	73	49	1001001x	i	105	69	1001011x
J	74	4A	0101001x	j	106	6A	0101011x
K	75	4B	1101001x	k	107	6B	1101011x
L	76	4C	0011001x	l	108	6C	0011011x
M	77	4D	1011001x	m	109	6D	1011011x
N	78	4E	0111001x	n	110	6E	0111011x
O	79	4F	1111001x	o	111	6F	1111011x
P	80	50	0000101x	p	112	70	0000111x
Q	81	51	1000101x	q	113	71	1000111x
R	82	52	0100101x	r	114	72	0100111x
S	83	53	1100101x	s	115	73	1100111x
T	84	54	0010101x	t	116	74	0010111x
U	85	55	1010101x	u	117	75	1010111x
V	86	56	0110101x	v	118	76	0110111x
W	87	57	1110101x	w	119	77	1110111x
X	88	58	0001101x	x	120	78	0001111x
Y	89	59	1001101x	y	121	79	1001111x
Z	90	5A	0101101x	z	122	7A	0101111x
[	91	5B	1101101x	{	123	7B	1101111x
\	92	5C	0011101x		124	7C	0011111x
]	93	5D	1011101x	}	125	7D	1011111x
^	94	5E	0111101x	~	126	7E	0111111x
_	95	5F	1111101x	DEL	127	7F	1111111x

Glossary

Active column

The horizontal position on the paper where the next character will print. After printing a character, the printer increments the active column.

Active line

The vertical position on the paper where the next character will print. After printing a character, the printer increments the active line.

Active position

The absolute position on the paper where the next character will print. The active position is defined by the active column (horizontal position) and active line (vertical position).

ANSI

American National Standards Institute.

Autowrap mode

An operating feature of the printer that lets you control what happens to print characters that exceed the right margin on the page.

Barcode

A graphic (printed or photographically reproduced) barcode composed of parallel bars and spaces of various widths. A barcode symbol contains a leading quiet zone, a start character, one or more data characters including in some cases a check character, a stop character, and a trailing quiet zone.

Baud rate

The speed at which the printer communicates with the host computer.

Block character

A mode of operation in the LG31 printer. Characters are plotted in sizes selected.

Character attribute

A feature of a highlighted character. These include underlining, bold printing, italic printing.

Character cell

An imaginary rectangle used as a unit of spacing. The height of a cell is equal to the current line spacing, and the width is equal to the current character spacing.

Character set

A set of modes that describe the general appearance of a set of characters. For example, a character set might contain the code for an uppercase A or the number 1. Character sets do not describe the style of a printing character. See Font.

Code table

A list of characters and codes for a specific character set. The table is divided into columns and rows that show each character with its binary, octal, decimal, and hexadecimal code. An 8-bit code table has twice as many columns as the 7-bit table.

Control characters

Characters that do not print, but cause the printer to perform some action. For example, the HTS control character sets a horizontal tab. There are two groups of control characters, C0 (0/0 - 1/15) and C1 (8/0 - 9/15).

C0 (control 0) and C1 (control 1) codes

C0 codes represent 7-bit ASCII control characters. C1 codes represent 8-bit control characters that let you perform more functions than possible with C0 codes. You can only use C1 codes directly in an 8-bit environment.

Control function

A method of controlling how the printer processes, sends, and prints characters. Control functions include control characters, control strings, and escape and control sequences. Appendix C compares the control functions used in the LG31 printer and the LN03 printer.

Control sequence

Two or more bytes that define a specific control function. Control sequences usually include variable parameters.

CR

Carriage return.

Decipoint

A unit of measure equal to 1/720 inch.

DEC Multinational Character Set

This 8-bit character set is the default character set when you turn the printer on. The left half of this set is the ASCII graphic set (7-bit compatible). The right half includes the C1 control characters and DEC Supplemental Graphic Set (8-bit compatible).

DEC Private

Digital control sequences not yet recognized by ANSI. The mnemonics for these sequences begin with DEC.

Default values (for escape sequences)

Standard values used for parameters. The printer uses a default value when you specify a 0 value or omit a value. For most sequences, the default value is 1.

Density

Dots-per-inch of the printed image.

Device control strings (DCS)

Like control sequences, a DCS uses two or more bytes to define a specific control function. However, a DCS also includes a command string.

Error code

A numeric code of four digits, used to report printer problems. See the LG31 Installation/Operator's Manual.

Error messages

Displayed messages that describe printer problems. See the LG31 Installation/Operator's Manual.

Escape sequence

Two or more bytes that define a control function. Escape sequences do not include variable parameters, but may include intermediate characters.

Extended page format

The page home line is at the top margin, and the page end line is at the bottom margin.

FF

Form feed.

Font

A size and style of type to use for printed characters. For example, a Data Processing 10 CPI font describes a certain style (data processing) and size (10 CPI) of a printed character. Fonts and character sets are independent of each other. You need to specify both a font and a character set to print characters.

Font attributes

The seven characteristics of a font that define how printed characters will look when you use that font: type family, spacing type size, scale factor, typestyle, character weight, and character proportion. These attributes are not affected by the character set you use.

Font file

The data for a unique combination of one font and one character set. You can assign a font to any character set available in the printer. The font files that come with the printer are stored in ROM.

Font file attributes

A set of 12 characteristics for the font and character set in a given font file. These include the seven font attributes plus the character set images, rotation, character subset, file encoding, and resolution.

Font ID

A 16-character code (no lowercase letters) that describes the seven basic font attributes (including type family) of the ROM fonts.

Font file ID

A 31-character code that describes the character set and font attributes for a given font file. Appendix D lists all standard type family, font, and font file IDs for the ROM font files.

Form

A string of text and control sequences in a specific format that can be stored in printer memory and repeatedly printed.

Form length

The vertical size of the printed area on a page. The maximum form length depends on the setting.

GL (graphic left) and GR (graphic right) codes

Two code tables in memory, reserved for printable characters. You store the character sets you want to print from in GL and GR.

The printer uses the graphic left (GL) table in memory when the character code format is 7-bit, or when the character code format is 8-bit and the graphic characters are in the 2/1 through 7/14 range.

The printer uses the graphic right (GR) table in memory when the character code format is 8-bit and the graphic characters are in the 10/0 through 15/15 range.

Input buffer

An area in the printer that can hold up to 1,000 characters received from the host computer before printing them. This buffer allows the printer and host computer to communicate independent of printing speed.

Initial values (for escape sequences)

The LG31 has permanently stored values for some escape sequences that control basic printing functions. The printer uses these initial values after you power up the printer or send a reset sequence.

ISO

International Standards Organization.

Justification

The alignment of printed text at the right margin. When you justify text, you change the spacing between the words. Justified lines have the first character of the first word at the left margin (or the line home position, if different), and the last character of the last word at the right margin.

Landscape printing

A method of printing characters vertically from the bottom to the top of the paper loaded in the printer.

Line home position

The active position on the printed page after a carriage return (CR). The line home position serves as the left edge of the page for justified text. A CR may move the active position forward or backward in order to reach the line home position.

Line end position

The right edge of the printed page for justified text.

Logo

A graphic image that can be printed by the LG31.

Margin

A setting that defines the printing area on the page. The printer cannot print outside a right margin, except when drawing vectors or doing justification. The left horizontal margin specifies the first printable position on a line. The right horizontal margin specifies the last printable position on a line.

Normal page format

The page home line is 1/2-inch below the top margin, and the page end line is 5/6-inch above the bottom margin.

Origin

The starting point for printing on the page. You can select either the corner of the printable area, or the corner of the physical page.

Page end line

Usually the last printable line on a page. When the printer receives a line feed (LF) on the page end line, the active position moves to the page home line on the next page.

Page format select (PFS)

An escape sequence that lets you select a page format from a list of standard formats. These formats select the character size, characters-per-line, and lines per page.

Page home line

The active line on the page after a form feed (FF). The page home line specifies where a form feed positions the first printable line on the page.

Parameter

A character that modifies the action or interpretation of a control sequence. All parameters are unsigned, positive decimal integers, with the most significant digit sent first.

- A numeric parameter indicates a numeric value such as a tab or margin location. In this manual, numeric parameters appear as actual values or as Pn, Pn1, Pn2, and so on.
- A selective parameter selects an action associated with the specific parameter value. In this manual, selective parameters appear as Ps, Ps1, Ps2, and so on.

Pixel

The smallest displayable picture element on a video screen. The printer prints pixels as dots. A pixel in LG31 is 1/600".

Portrait printing

A method of printing characters horizontally across the paper loaded in the printer.

Printable area

The printable part of a page. On the LG31 (and most printers) you cannot print to the physical left or right edge of the page.

Printable characters

The characters the LG31 recognizes to print.

RAM

Random access memory.

Received characters

Printable characters and control functions that the printer receives from the host computer. The printer can process 7-bit and 8-bit data.

Reset sequence

An escape sequence that resets several printer operating features to an initial state. There are two sequences you can use to reset the LG31.

Resolution

The number of dots printed in a defined area. The maximum resolution of the LG31 is 200 dots-per-inch.

ROM-resident fonts

The standard fonts that come with the printer. These fonts are permanently stored in the printer's Read Only Memory (ROM).

Select graphic rendition (SGR) number

A number you must assign to a font file to make it available for printing.

Serial character format

The sequential arrangement of the bits of a data character. The printer sends and receives characters in this format. A serial character has a start bit (space), 7 or 8 data bits (1 = mark, 0 = space), a selectable parity bit, and a stop bit (mark).

Sixel

A single character code representing six vertical bits of an image.

Sixel protocol

A protocol that enables printing of black and white bit map data at various sizes. It is encoded as a Device Control String.

Tab stop

A preselected point that the active position moves to when you send the printer a tab control character. The active position is where the next character prints.

Type family

A group of fonts with a similar design, but differing in the six other font attributes. For example, Data Processing is a type family used in the LG31.

Vectors

Lines drawn with length, width, and horizontal or vertical direction. Margins do not affect line drawing. If you try to draw a line beyond the physical limits of the page, the printer will print the part of the line that occurs within the page. The printer draws lines without modifying the active position.

XON/XOFF protocol

A method of synchronizing data communication between the printer and the computer. The printer sends XON and XOFF signals to tell the computer when to start or stop sending data. The XON/XOFF protocol prevents the printer's input buffer from overflowing. Otherwise, data might be lost if the printer stops for some reason (a paper-out condition, for example) or if the communication speed is greater than the print speed.

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